A Component of
British Columbia's
Land Use Strategy

Central Coast
Land & Coastal Resource Management Plan

Socio-Economic & Environmental/Marine Base Case: Final Report

prepared by

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November 2000

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COLUMBIA

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TO: Central Coast Inter-agency Planning Team (IPT) and LCRMP Table Members
RE: Socio-Economic & Environmental/Marine Base Case Report
FROM: Gord Enemark, Ministry of Employment and Investment
DATE: November 24, 2000

Attached is the final version of the *Central Coast LCRMP Socio-Economic & Environmental/Marine Base Case* report, which attempts to address comments received on the previous draft (September 1999). Recall that the objective of this work is to assess current and anticipated socio-economic/environmental trends in the Plan Area **in the absence of a Land/Coastal Use Plan,** for two key purposes: (1) to assist the Table in prioritizing key socio-economic and environmental issues it may want to address in its final LCRMP recommendations; and (2) to provide analysts with a "starting point" from which to assess the implications of a future Land/Coastal Use Plan to be proposed by the LCRMP.

Since the LCRMP is engaged in "high level" or "strategic" land/coastal use planning for a nearly five million hectare (plus coastal areas) region, the Base Case report by necessity also takes a similar "broad-brush," Plan Area-wide approach. However, we have attempted to discuss the "North" and "South" portions of the Plan Area separately where there was available information and where it was felt appropriate to do so. Therefore, except in certain key instances where a "local" or "watershed" issue had special significance, the analysis takes a generalized approach in terms of its geographic perspective.

This work is done in as balanced and value-neutral a fashion as possible, by analysts who are at "arms-length" from both the IPT and the entire LCRMP process. Note that Part 1 (*Socio-Economic*), in addition to my own work, contains some research input from consulting economists G.E. Bridges & Associates and G.S. Gislason & Associates. The remainder of the report contains the environmental analysis: Part 2 (*Environmental - Terrestrial*) was undertaken by Eliot Terry (R.P. Bio.) of Keystone Wildlife Research, Part 3 (*Environmental - Marine*) is by Jacqueline Booth (B.Sc.), and Part 4 (*Environmental - Anadromous/Freshwater Fisheries*) is by Violet Komori (B.Sc., M.R.M.)

The approach taken in this report conforms as closely as possible with the principles contained in the provincial government's publication, *Social and Economic Impact Assessment for LRMP in BC: Interim Guidelines* (1993). This document states that "Considerable uncertainty may exist around the trends associated with the Base Case. The most likely trends should be described, along with the key factors influencing them…." In most cases, these "key factors" include the effects of resource industries. Given that these industries create socio-economic benefits as well as potential impacts on other values, it is our responsibility as analysts to address both. The LCRMP Table then has the task of striking a balance among these various impacts in its eventual Land/Coastal Use Plan recommendations. And while there will not be complete agreement with the content, I urge participants to also focus on that content for which there is general agreement and which adds relevant technical information to the deliberations.

If you have any questions or concerns regarding the Base Case report, I can be reached at 250-952-0699 (using the toll-free 1-800-663-7867 Enquiry BC line if you wish) or via E-Mail at gordon.enemark@gems8.gov.bc.ca. If you would like to liaise directly with the consultants, Eliot can be reached at 250-964-3229 (E-Mail: keystone_pg@telus.net), Jacky is at 250-653-4761 (E-Mail: booth@saltspring.com), and Violet can be contacted at 250-336-8851 (E-Mail: komori@island.net).

Central Coast

Land and Coastal Resource Management Plan

Base Case

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Part 2: Environmental - Wildlife

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Central Coast
Land and Coastal Resource Management Plan

Base Case

Part 1

Socio-Economic

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Section 1 Summary Matrix: Socio-Economic Base Case

Socio-Community Account - Base Case Trends	
General	• The Central Coast LCRMP Plan Area is ~4.8 million hectares, ~50% larger than Vancouver Island. It includes most of the Mid-Coast Forest District (FD) & a small portion of the North Coast FD as the "North" portion of the Plan Area (pop. ~4200); the "South" portion (pop. ~400) contains the mainland portions of the Pt. McNeill and Campbell River FDs & the Smith Inlet portion of the Mid Coast FD. • The Plan Area also includes the better part of 4 DFO "Statistical Areas" (#6-#9) in the North & 4 in the South (#10-#13); there are portions of 2 BC Environment Regions in the North & 2 in the South; and 5 First Nations claim traditional territories in the North & 14 in the South. • 10.7% of the Plan Area is currently in fully/partly Protected Areas and a further 65 terrestrial areas, covering 6.7% of the Plan Area, have been assigned "Study Area" status by the provincial government; 42 of these Study Areas are located in the northern portion of the Plan Area (a number of other areas have also been identified by CCLCRMP participants as candidates for protection). • The communities of Bella Coola, Hagensborg, Ocean Falls, Klemtu, Rivers Inlet (Oweekeno), Namu, Shearwater, Firvale, Stuie & Bella Bella are within the Plan Area, all of which are located in the North. • ~50% of residents live in the Bella Coola/Hagensborg area (Regional District Electoral Areas C, D, & E), which is the major centre in the Plan Area, with another ~25% in the Bella Bella area (Electoral Area B). • ~95% of the population of the southern part of the Plan Area is aboriginal, located in five very small communities: Kingcome, Gilford, New Vancouver, Hope Island, and Hope Town. • While population growth in recent years has been strong, the provincial government's (BC STATS) forecast for the Plan Area is for no growth over next 25 years, due to out-migration and aging population; however, BC STATS acknowledges the uncertainty in forecasting for small areas and First Nations believe that their populations will continue to grow rapidly, which would cause overall Plan Area population to increase.
First Nations	• First Nations on reserve comprise >50% of the overall Plan Area population and include the Heiltsuk, Kitasoo, Nuxalk, & Oweekeno, in the North and the Kwicksutaineuk, Tsawataineuk, Kwa-Wa-Aineuk, Tlatlasikwala, and Da'naxda'xw in the much less populous South; also many members of some of these First Nations live on northern Vancouver Island but claim traditional territories in the Plan Area, e.g., the Kwakiutl (KDC) & Musgamagw-Tsawataineuk (MTTC) groups. • In 1996, ~30% of the on-reserve labour force in the Plan Area worked in the fishing/forestry industries; this has since declined due to BC-wide economic problems in these resource sectors. • Several Plan Area First Nations indicate that key concerns are sustainability of fish/wildlife, unemployment rates approaching 90% in some cases, lack of training/capacity, lack of control over land & resources, the recent extreme downturn in fisheries employment, and lack of meaningful forestry jobs. • There are several First Nations with traditional territories in the Plan Area that are currently involved in treaty negotiations, comprised of the Heiltsuk, Oweekeno, Homalco, Haisla, Tsimshian, Kwakiutl, and Namgis; claims settlements, including likely financial compensation from the federal government, should eventually increase future economic stability in the Plan Area. • MTTC/KDC/Tlowitsis have protocol concerns re industries such as tourism & mining, and would like more significant participation in forestry; it is also understood most of their members have strong concerns about salmon farming, as do the Heiltsuk.
Employment & Income	• Main economic drivers are forestry, fishing, tourism, aquaculture, and the public sector/transfer payments. • Over 90% of the ~2200-member resident labour force is located in the northern part of the Plan Area. • The Plan Area labour force grew by 38% from 1986 to 1991, mostly due to increases in the services and public (i.e., government/health/education) sectors. • The Census unemployment rate in 1996 was 15% (this does not include "discouraged workers" who have dropped out of the labour force) and was a reduction from the 1986 and 1991 levels; however, the rate has worsened since due to the declines in the forestry and fishing sectors. • The 1996 average tax filer income for the Plan Area was ~$18,000/yr. vs. ~$28,000/yr. for BC overall. • Economic growth is expected to continue to be slow, and opportunities appear to be mainly within the forestry, tourism, and aquaculture sectors; reduced timber harvests expected in both short & long term.
Inter-Regional Linkages	• Many communities outside of the Central Coast benefit from the resource activities that occur in the Plan Area, primarily on northern Vancouver Island (where the local economy is also currently poor) and the Lower Mainland - about 96% of forestry jobs, 95% of aquaculture jobs, over half of tourism jobs, and an unknown number of fishery jobs that are generated in the Plan Area are held by non-resident workers; this is also a clear indication of the close economic linkages the Plan Area has with other nearby regions • More future joint ventures between the private sector & local First Nations may alter the foregoing statistics. • Non-Plan Area communities also benefit from significant expenditures made by the logging, commercial fishing, aquaculture, and tourism industries that operate in the Plan Area, but local businesses in the Plan Area would like to see more spending accrue to local merchants.

Economic Development Account - Base Case Trends

Forestry	• The northern portion of the Plan Area consists of most of the Mid Coast Forest District (FD) and a small portion of the North Coast FD; the southern portion consists of the mainland portions of the Port McNeill, Campbell River, and a small portion of the Mid Coast FD. • The total AAC of the Central Coast LCRMP area is ~4 million m^3/yr, with ~35% in TFLs. • ~8% of North Plan Area and ~20% of South Plan Area is "Timber Harvesting Land Base" (THLB). • ~20% of the THLB is covered by Preservation, Retention, & Partial Retention VQOs in the North & South, with remainder mostly managed under minimum Forest Practices Code (FPC) requirements. • Timber harvesting is the largest industry in the Plan Area, accounting for ~26% of 1996 personal incomes of Plan Area residents & 21% of local employment; ~4400 full-time equivalent jobs are linked to the Plan Area harvest - ~96% of these forest workers have permanent residence outside the Plan Area since virtually all of the timber harvested is transported to mills on Vancouver Island or the Lower Mainland for processing. • There is one value-added manufacturer in the Plan Area, near Bella Coola. • Jobs tied to the Plan Area AAC will likely decline over time, due to "fall-down," the FPC, rationalization, and environmental/market pressures to undertake a more "ecosystem-based approach" to logging; a rough estimate is that even under minimum FPC rules, the harvest will fall by at least 500,000 m3/yr (~12%) during next 2 decades, which would support 1 sizable sawmill and ~200 woodlands jobs (~20 in Plan Area).
Commercial Fisheries	• Fishing/processing resident jobs have declined from >400 in early 1990s to <300 today. • As of 1996, fishing/processing provided almost 14% of resident employment and 8% of personal income in the Plan Area; 1997 estimates total ~300 seasonal fisheries jobs, which may include some non Plan Area residents (~170 in salmon harvesting, ~100 in herring spawn-on kelp, and ~30 in processing/distribution); likely more declines in salmon fleet jobs since 1997; while some non-residents capture (primarily salmon & roe herring) fisheries in the Plan Area, local residents also fish in non-Plan Area coastal waters. • While more local jobs are in salmon harvesting, spawn-on-kelp generates more local income and is a key fishery to local First Nations; the harvesting of shellfish, roe herring (most license-holders live outside the Plan Area), and other non-salmon species are also significant. • There was a large decrease in processing jobs from 1991-96 and a decline in salmon fishing jobs (Plan Area & BC, especially among aboriginals) since mid-1990s due to declining stocks, causing voluntary license "buy-backs;" outlook for near future is not promising for salmon, but is more optimistic for other species.
Aquaculture	• There are 54 salmon & 4 shellfish farms in the Plan Area; all except one are located in the South • Plan Area produces ~47% of the $ value of all BC farmed salmon, resulting in ~640 (mainly non-seasonal) direct jobs, with ~95% of workers residing outside the Plan Area, mostly on northern Vancouver Island. • The October 1999 Salmon Aquaculture Policy (SAP) announcement freezes the number of tenures in BC at 121 and provides for ten additional salt and fresh water pilot projects for research on closed containment technology, will relocate poorly sited operations, and introduces additional environmental standards. • Since all 85 existing BC salmon farms occupy <1000 ha., even excluding those areas precluded by the new SAP environmental standards, there would be significant unutilized areas for expansion of salmon farms, should the 121 upper limit ever be increased. • Demand-side outlook is for growing world markets for both farmed salmon and shellfish. • Some First Nations and other interest groups have strong concerns about the environmental and other implications of salmon aquaculture.
Tourism & Recreation	• The Central Coast offers high quality outdoor recreation opportunities such as sport fishing (50 lodges) boating/kayaking, back-country hiking, and hunting • As of 1996, tourism (includes business travel) accounted for 16% of resident employment and 10% of income in the Plan Area; Census data indicates growth during 1986-96. • Tourism estimated to provide 540 (largely seasonal) jobs; ~40% of workers reside outside the Plan Area. • Plan Area's sport fishing sector accounts for ~1/3 of tourism jobs, but saltwater component facing challenges throughout BC due to declines in some stocks & inaccurate perceptions abroad regarding assumed closures. • About 1/3 of MSBTC "Priority #1" visually sensitive areas in the THLB are in Preservation, Retention, and Partial Retention VQOs, but key areas will still be compromised gradually over time. • Undeveloped Watersheds (UWs) considered important for some components of wilderness tourism will decline over time as roaded resource development continues (half of North Plan Area and <1/3 of South Plan were UWs as of early 1990s); similar trend for Recreation Opportunities Spectrum (ROS) inventory. • Although new roads will increase access that benefit some types of tourism, certain nature-based values will continue to be compromised under Base Case management as timber harvesting and associated road development proceeds in undeveloped areas over the long term; more coastal nature-based values will also be compromised due to ongoing human activities (e.g., aquaculture, log dumps, lodges, settlement, etc.) • Overall, commercial tourism/business travel is still likely to continue to grow gradually into the foreseeable future, but growth is highly dependent on the health of the sport fishing sector.

Economic Development Account (cont.) - Base Case Trends	
Agriculture	• In 1996, agriculture contributed 2% of Plan Area employment & 1% of personal income (all in the North); about 40 jobs in total. • Number of farms has increased from 18 in 1991 to 30 ($392,000 in revenues) in 1996. • ~4400 ha. of ALR & 6 grazing tenures in the Bella Coola valley, occupying ~2200 ha. • Future growth likely low; constrained by soils, small local market, & distance from larger markets.
Mining & Energy	• There is currently no documented mining employment or operating mines or in the Plan Area, but geology is favorable and MEM considers the area to be "under-explored." • There are 2 "Developed Prospects," 22 "Past Producers," & ~15,000 ha. in mineral tenures in the Plan Area. • There are some relatively promising candidates for future metal and industrial mining activity (e.g., potential 42-job aggregate project near Bella Coola), including re-activation of some past producers, but probabilities/timing of future developments are uncertain.. • There is no oil/gas activity in the terrestrial portion of the Plan Area, and potential is low; the primary sources of electricity are diesel and small-scale hydro since the Plan Area is not on the BC Hydro grid. • There is some long term potential for geothermal energy in the Plan Area. • Significant oil/gas potential offshore exists in Queen Charlotte Sound and Hecate Strait, but moratorium on development currently in effect.
Hunting, & Trapping	• Economic contributions relatively minor, but subsistence and traditional values of these activities are significant, particularly to First Nations. • 8 guide-outfitter territories in Plan Area & a significant amount of non-commercial hunting - key species are grizzly, black bear, deer, goat, & moose; *Environmental Base Case* analysis indicates grizzlies are vulnerable over long term, with higher risks in the south portion of the Plan Area. • Trapping is significant for First Nations, who have concerns re habitat disturbance - key species are marten, beaver, & mink; reported marten and mink harvests on downward trend, but trapper effort trend is unclear.
Botanical Forest Products	• Pine mushrooms are relatively common in the Plan Area & provide some seasonal income that varies from year to year; in good years, there are a great deal of non-resident pickers and buyers; ~100 tonnes of pine mushrooms were shipped out of the Plan Area in 1999. • Other marketable products include other types of mushrooms, western yew bark, wild berries, cedar oil, floral greenery, and various medicinals. • MTTC/KDC/Tlowitsis indicate that the south portion of Plan Area historically has been rich in medicines, food, dress, tools, and cultural implements that come from both terrestrial and marine areas. • Compatibility of botanicals with traditional forest practices depends on the product in question; pine mushrooms are most compatible with selective timber harvesting, but not necessarily closed canopy forests. • Lack of data makes future trends difficult to judge, but research indicates that both market and supply potential for BC products is promising.

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1. INTRODUCTION

In July 1996, the Central Coast Land and Coastal Resource Management Planning (LCRMP) process was announced. The LCRMP is a consensus-driven, multi-stakeholder public and government agency consensus-based process to plan for Crown land and coastal resources, including the establishment of new terrestrial and marine Protected Areas. Several other similar strategic (i.e., "high level") land use planning processes throughout the province have achieved consensus, however the Central Coast is the first to incorporate a marine/coastal planning component.

A logical step in such planning processes is to better define the current socio-economic and environmental situation and likely future trends in the area in the absence of a land/coastal use plan; this report is meant to provide such a "Base Case" analysis of the Plan Area. It will also provide a brief summary of issues and concerns expressed by stakeholders and other interested parties. The report can be used by LCRMP participants to inform the discussions on the development of socio-economic and environmental objectives for the plan. The Base Case will also be used by analysts as the "benchmark scenario" for comparison with the recommended LCRMP plan in the eventual "Multiple Accounts" impact assessment work.[1]

The Base Case land use regime includes the implications of the *Timber Supply Review* (TSR) management regime, the *Forest Practices Code* (FPC), and other current management initiatives of government (e.g., the *Mining Rights Amendment Act*, the *Mineral Exploration Code*, the recent *Salmon Aquaculture Policy*, DFO's stock management regulations, etc.). First Nations' land claims are also occurring as part of overall Base Case trends, although claims in the Plan Area have not been resolved. The Central Coast LCRMP Plan Area encompasses a large region of the BC Coast, representing approximately 4.8 million hectares (ha.). It is approximately 50% larger than Vancouver Island and includes portions of the Kitimat-Stikine, Central Coast, Cariboo, and mainland portions of the Mount Waddington and Comox-Strathcona Regional Districts. Due to its size and differing socio-economic characteristics, the Plan Area has been divided into "North" and "South" portions as shown in Map 1.

A full 10.7% of the Plan Area is in a fully or partially protected status, with Tweedsmuir Park and the Hakai & Fiordland Recreation Areas comprising most of that amount. An additional 65 Cabinet-approved terrestrial "Study Areas" (some with a marine component) covering 6.7% of the Plan Area are candidates for protection; of these, 42 are located in the northern portion of the Plan Area. There are also additional candidates being proposed for protection by LCRMP table members. It should be noted that a 12% target for new Protected Areas does not apply specifically to the Central Coast LCRMP Plan Area or to other LRMPs, but rather refers to the target for the province as a whole, as set by the provincial government in the early 1990s.

Finally, since First Nations make up more than half of the Plan Area's population, their participation in the process was actively encouraged and several are at the table. Among other things, this document attempts to identify First Nations socio-economic circumstances and land use concerns, based upon the available information.

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[1] Further analysis will be done for the eventual socio-economic/environmental "Multiple Accounts Assessment" of the recommended Central Coast land/coastal use plan at both the regional and provincial levels, once the LCRMP has produced such a product. Note that none of the analysis is meant to recommend any land use changes; rather, the intent is to provide an objective assessment of the economic, social, and environmental implications of the Base Case land use regime and, eventually, of the proposed Scenario(s).

2. Socio-Community Overview

2.1 Population

As of the 1996 Census, the population of the vast Central Coast Plan Area was a relatively low 4,611. None of the communities in the Plan Area are incorporated municipalities. The main population centres are in the Bella Coola valley (i.e, the Bella Coola, Hagensborg, Firvale, and Stuie areas) where about 2400 aboriginal and non-aboriginal residents reside and in Waglisla (Bella Bella) where there are about 1200 on-reserve Heiltsuk inhabitants. The remainder of the Plan Area is very sparsely populated. Additional communities are Klemtu (a mainly Kitasoo community), Ocean Falls, Shearwater, and Rivers Inlet (Oweekeno). All of the foregoing communities are located in the North portion of the Plan Area. Some very small First Nations communities are located in the South part, the largest of which are at Kingcome and Gilford Islands; however, the 1996 Census indicates 10 aboriginal reserves are located in the South. Most, but not all, members of First Nations that have traditional territories in the southern portion reside in Alert Bay, Port Hardy, Campbell River, Comox/Courtenay, or Cape Mudge.

There were some population declines in the Plan Area in the 1960s and 1970s due in large part to the number of individuals who left Ocean Falls after the closing of its pulp mill. Recently, however, the population of the Plan Area has grown due to a number of factors, including the in-migration of residents and a relatively high birth rate. According to Census data, the population of the Plan Area has been increasing quite strongly in recent years, as shown in Table 1. Just over 50% of the total population are aboriginals living on-reserve, and a portion of the remainder would also be of First Nations origin; a recent local study[2] estimates that about 1800 of those who live in the Bella Coola valley are non-aboriginal. Available population trends for Plan Area communities are contained in Table 2.

Table 1: Central Coast Plan Area vs. BC Population Trends

	1986	1991	1996	% Change 1986-1991	% Change 1991-1996
North	3,351	3,864	4,232	+15%	+10%
South	425	323	379	-24%	+17%
Total Plan Area	**3,776**	**4,187**	**4,611**	**+11%**	**+10%**
Province	**3,020,400**	**3,379,800**	**3,724,500**	**+12%**	**+10%**

Source: *1986, 1991, & 1996 Census*: Statistics Canada.

Table 2: Population of Larger Communities in the Central Coast Plan Area

	1991	1996	% Change 1991-1996
Bella Coola Area	1,335	1,517	+13.6%
Bella Bella Area	1,104	1,211	+9.7%
Hagensborg, Firvale, Stuie	804	883	+9.8%

Source: *Mid-Coast TSA Timber Supply Review*: Ministry of Forests, June 1999.

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[2] *Central Coast Regional District Forest Sector Strategy*: PMF Consulting, 1999.

The average age of death within the Plan Area is substantially younger than the province as a whole. This is partly due to the gender balance in favor of males, and partly due to the high concentration of aboriginals who tend to have lower life expectancies than non-aboriginals.

The provincial government's statistical agency, BC STATS, has a model that projects the Central Coast Regional District (home to over 90% of Plan Area residents) population will experience essentially no growth between 2000 and 2025, in spite of the recent high growth rates. This anticipated trend is in stark contrast to the anticipated 45% growth in the BC population projected by BC STATS to occur over the same time period. While BC STATS staff do not expect significant future population growth in the Plan Area due to continuing out-migration (driven by expected slow economic growth) and an aging of the population (which reduces the number of women in the child-bearing age groups) it is acknowledged that the model is less accurate for areas of low/sparse population.[3] In addition, several First Nations in the Plan Area believe very strongly that their populations will continue to grow; in fact, the Heiltsuk have undertaken a demographic analysis that indicates its population will increase significantly in the future.

2.2 Education

Comparing 1986 to 1996 census data indicates that the number of individuals in the Plan Area with Grade 12 or less is declining over time, with a commensurately larger proportion having university or other post-secondary education. This trend is most pronounced in the northern portion of the Plan Area.

Table 3: Central Coast Plan Area and Provincial Education Levels: Population Age 15+

	1986			1996		
	Grade 12 or less	**University**	**Other Post Secondary**	**Grade 12 or less**	**University**	**Other Post Secondary**
North	64%	12%	24%	52%	15%	33%
South	53%	24%	22%	55%	17%	38%
Total Plan Area	**63%**	**14%**	**24%**	**52%**	**15%**	**34%**
Province	**56%**	**24%**	**20%**	**48%**	**25%**	**27%**

Source: *1986 & 1996 Census:* Statistics Canada.

2.3 First Nations

2.3.1 First Nations Populations within the Plan Area

An estimated 2455, or 53% of the 4611 resident population in 1996 were members of First Nations living on-reserve in the Plan Area. It is understood that there are nine First Nations with residents in the Plan Area, four in the northern portion and five in the southern portion. The following provides profile information on each of these "resident" First Nations:[4]

Heiltsuk

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[3] D.Schrier, Population Analyst, BC STATS: *pers. comm.* BC STATS also indicated there are further modeling problems peculiar to the Central Coast situation.

[4] The profiles provided in this section were prepared based, in part, on information obtained from Indian and Northern Affairs Canada.

The Heiltsuk First Nation belong to the Wakashan linguistic group, and are the most populous First Nation residing in the Plan Area with a reported 1998 on-reserve population of 1192. This First Nation manages 22 reserves on 1,370 hectares in Waglisla (formerly Bella Bella) on Campbell Island, although the Heiltsuk state that there were many villages throughout the Plan Area prior to the late 1800s. The Heiltsuk have a traditional territory that covers a significant region of the northern portion of the Plan Area and also operate the Heiltsuk Tribal Council (HTC). There are 361 dwellings on the reserve, a Band office, community hall, three schools (college, elementary, secondary), day care center, and two churches. Economic activities include commercial fishing, a fish processing plant, a salmon hatchery, logging, some small scale timber processing, tourism, the Bella Bella airport, a shipyard, Heiltsuk cable TV, a contracting company, the Band store, and some FRBC-sponsored silviculture/watershed restoration work. A survey conducted by the Heiltsuk in 1997 conducted that 75% of the employable workforce did not have full-time, year-round employment and it is understood that 60%of the unemployed were between the ages of 21 to 50.

Kitasoo

The Kitasoo First Nation is part of the Wakashan linguistic group, and about half the members are Tsimshian and half are Heiltsuk. This First Nation manages 15 reserves on 598 hectares and is part of the Oweekeno Kitasoo Nuxalk Tribal Council (OKNTC). The main community, Klemtu, is located on the east shore of Swindle Island, northwest of Ocean Falls, on Kitasoo #1. There are 79 dwellings, electricity is diesel-generated, and communication is conducted by radio phone and community satellite. Other facilities include the Band office, a community hall, drop-in center, boardwalks, elementary/high schools, a church and a post office. Economic activities include a sawmill, Kitasoo Seafood Processing, a fish farm, the band store, sport fishing, and an ice plant.

Nuxalk

The Nuxalk First Nation is part of the Salish linguistic group and also belong to the OKNTC. According to the Nuxalk, there were at one time 45 inhabited sites on the Central Coast, primarily along the Fisher, Dean, and Burke Channels and North and South Bentinck Arms. Today, this First Nation manages seven reserves on 2,024 hectares, but the only one presently occupied is at Bella Coola. The Nuxalk also indicate that their population has more than doubled from 542 in 1981 to 1166 (with 761 on-reserve) in 1995, due in part to reinstatement of status through the Canadian government's Bill C-31. There are 261 dwelling units, as well as a Band office, a fire department, nursing station, a community hall, social services clinic, a school, college, and a senior's home. Economic pursuits include several small stores, silviculture, commercial fishing, an ice plant, and there is some interest in joint-venturing with major forest licensees. Businesses not currently operating for economic reasons include a portable sawmill, smoker plant, and a fish processing plant.

Oweekeno

This OKNTC First Nation is part of the Wakashan linguistic group, managing three reserves on 713 hectares, with their mainland community located at Rivers Inlet. Electricity for the 24 dwellings is diesel-generated and telephone service is provided by radio phone. Other facilities include a Band office, community hall, and drop-in centre. Some employment is provided in silviculture and watershed restoration projects, and via salmon enhancement work. Of those living off-reserve, many are on northern Vancouver Island. The Oweekeno are constructing a new school and band office, and have plans for a nearby airstrip.

Kwicksutaineuk

The Kwicksutaineuk are also part of the Wakashan linguistic group and have a community on Gilford Island in the southern portion of the Plan Area, approximately 40 km east of Port Hardy near the entrance of Knight Inlet. This First Nation manages ten reserves on 179 hectares with 23 dwellings and is a member of the Musgamagw Tsawataineuk Tribal Council (MTTC). Other facilities include the Band office, community hall, and a utility building. Some economic potential for the community is available in the forestry and tourism sectors.

Tsawataineuk

This MTTC First Nation manages five reserves on 218 hectares located in Kingcome Inlet, north of Alert Bay across the Queen Charlotte Strait. There are 46 dwellings on the reserve. Other facilities include the Band office, community hall, school, longhouse, and church. Commercial logging, fishing, and silviculture provide some seasonal employment.

Da'naxda'xw, Tlatlasikwala, and Kwa-Wa-Aineuk

These are three very small communities in the southern portion of the Plan Area, about which published information is scarce. However, information provided by the MTTC/KDC/Tlowitsis states that the Kwa-Wa-Aineuk are located at Hopetown and the Da'naxda'xw and the Tlatlasikwala are currently "repatriating" their communities at New Vancouver and Hope Island respectively.

Table 4 lists these groups and summarizes their resident and non-resident populations.

Table 4: Population of First Nations Currently Residing in the Plan Area

First Nation	Tribal Council	On-Reserve Population	Off-Reserve Population (in & outside Plan Area)	Total Population
Heiltsuk (North)	HTC	1,200	930	2,130
Kitasoo (North)	OKNTC	315	133	448
Nuxalk (North)	OKNTC	700	521	1,221
Oweekeno (North)	OKNTC	70	147	217
Kwicksutaineuk (South)	MTTC	39	196	235
Tsawataineuk (South)	MTTC	110	62	172
Kwa-Wa-Aineuk (South)	MTTC	18	9	27
Tlatlasikwala (South)	KDC	3	38	41
Da'naxda'xw (South)	KDC	n/a	n/a	n/a
Total		**2,455**	**2,036**	**4,491**

Sources: Indian and Northern Affairs Canada, November 1998; MTTC/KDC/T correspondence, March 2000.

2.3.2 Other First Nations with Traditional Territories in the Plan Area

In addition to the nine First Nations listed above, there are numerous First Nations whose members now reside primarily outside (although nearby) the Plan Area but indicate that they have traditional territories within. As shown in Table 5, these First Nations include members of the Kwakiutl District Council, the Musgamagw-Tsawataineuk Tribal Council, the Gitga'at (Hartley Bay), the Homalco, the Tlowitsis-Mumtagila, and the Haisla. It should also be emphasized that while relatively low numbers of KDC/MTTC currently live in the Plan Area, many of those residing outside have a strong attachment to these lands; in some cases, First Nations (e.g., the Gwa-Sala-Nakwaxda'xa in the 1960s) were in fact relocated by the federal government from the Plan Area to Vancouver Island.

Table 5: Population of Non-Resident First Nations with Traditional Territories in Plan Area

First Nation	On-Reserve	Off-Reserve	Total
Kwakiutl District Council (KDC):			
• Comox (Courtenay)	118	146	264
• Gwa'Sala-Nakwaxda'xw (Pt. Hardy)	435	160	595
• Kwakiutl (Pt. Hardy)	326	265	591
• Kwiakah (Campbell R.)	0	18	18
• Mamaleleqala-Qwe'Qwa'Sot-Enox (Village Is.)	0	228	228
• Quatsino (Coal Harbour)	198	144	342
• We Wai Kai (Cape Mudge)	322	482	804
• We Wai Kum (Campbell River)	200	358	558
Musgamagw-Tsawataineuk Tribal Council (MTTC):			
• Namgis (Alert Bay)	714	692	1,406
Others:			
• Tlowitsis-Mumtagila (Tsitika R./Alert Bay)	7	310	317
• Homalco (Campbell R.)	137	252	389
• Haisla (Kitimaat)	646	786	1,432
• Gitga'at (Hartley Bay)	182	419	601
Total	**3,285**	**4,260**	**7,545**

Source: Indian and Northern Affairs Canada, November 1998.

2.3.3 First Nations Concerns

It is likely that in most of the Plan Area's First Nations communities, unemployment exceeds 50%, which is obviously a major local concern; the existing socio-economic situation being described by one First Nation as "desperate." In addition, as part of the research effort for this report, a questionnaire was distributed to the various First Nations participating in the LCRMP, requesting further information on socio-economic conditions, aspirations, and geographic interests in the land and coastal resources within the Plan Area. The Nuxalk reponse, which essentially listed its key concerns, is summarized as follows:

- *Sustainability of finfish (mostly salmonids), shellfish, roe-on-kelp, marine mammals, waterfowl, a variety of birds (e.g., raptors, upland gamebirds, waterfowl), commonly hunted wildlife, pine mushrooms, medicinal plants, berry-bearing vascular plants, wood resources for cultural/sustenance purposes, and various unspecified marine/terrestrial areas of cultural and spiritual significance.*
- *Lack of available training in areas such as small business, policing, forestry, accounting, teaching, carpentry, child care, tourism, heavy equipment operations, mechanics, and office procedures*

- *"Self-directed" economic development, aimed at reducing the unemployment rate via such pursuits as fishery/forestry resource management, a Nuxalk forestry tenure, value-added wood processing, logging and silviculture, eco-tourism, and human/natural resources training*
- *Outside silviculture contractors under-bidding Nuxalk companies*

- *Lack of access to and benefits from what the Nuxalk believe is their own resource base, and therefore the pursuit of self-government of traditional lands and resources is desired*
- *Jobs should stay within communities for all locals to be able to work. Raw logs should stay in Bella Coola, and not shipped out. Multinational companies with short-term interests clear-cut big areas in about 5 years, whereas it would take the local community 50 years.*

In addition, the Heiltsuk First Nation has provided information that indicates its main socio-economic and cultural concerns are:

- *Achieving greater control over planning and management of the land/ resources in Heiltsuk traditional territory and providing mechanisms to support Heiltsuk involvement in such work within Heiltsuk territory; such mechanisms should help avoid future infringement of aboriginal rights - an example provided is participation by the Vancouver Island's Nuu Chah Nulth First Nations on a newly established "regional aquatic management board."*
- *Reflecting the values and objectives presented by the Heiltsuk regarding land and resource use and management within their traditional territories.*
- *Regarding salmon aquaculture, there is strong opposition to such ventures within traditional territories.*
- *Maintaining a relationship of mutual respect that reflects the provincial government's recognition of First Nations inherent right to self government and does not undermine or prejudice the treaty process entered into by the Federal, Provincial, and Heiltsuk governments.*
- *Recognising that aboriginal rights are constitutionally protected and cannot be infringed by the implementation of any product of the CCLCRMP.*
- *Increasing training and capacity-building such that the Heiltsuk are better positioned to take advantage of economic opportunities.*
- *Continuing ability to undertake the harvesting of traditional resources.*
- *Potential restrictions of traditional uses in the Hakai Recreational Area due to a possible "Class A Park" designation, further complicating Heiltsuk land claims to Aboriginal title and rights.*
- *Insufficient employment/revenue for the Heiltsuk from the forest sector, considering that the majority of the Mid Coast Forest District is made up of Heiltsuk territory.*
- *Perceived declines in Chum, Pink, Sockeye, and Ooligan stocks in the Plan Area and needed inventories/rehabilitation for key streams and potentially excessive future harvesting pressure on other food fisheries (e.g., halibut, ling cod, red cod, clams, crabs, etc.)*

The KDC/MTTC/Tlowitsis have indicated that their key First Nations concerns, confined mainly to the southern portion of the Plan Area, are as follows:

- *jurisdiction over land/water/resources (Treaty process)*
- *high unemployment rates in the traditional territories where resources are being exploited and more meaningful participation in forestry, in addition to seasonal silviculture jobs*
- *capacity issues within each First Nation*
- *policies or decisions that lack First Nations input and lack of respect in following individual First Nation protocol (e.g., tourism and mining)*
- *the farming of Atlantic salmon in Pacific waters*

While it is difficult to generalize,[5] it appears that improving economic opportunities, gaining more control over land and resource management, and protecting culturally important nature-based values (e.g., fisheries, hunting opportunities, botanical forest products, etc.) are the most significant priorities for those First Nations involved in the LCRMP.

The initiative that is likely of highest concern to local aboriginals (but is not part of the LCRMP process) is the settlement of outstanding land claims. First Nations have a special interest in the LCRMP because of these claims, their constitutionally protected rights, and their long history of occupancy on the Central Coast. Several First Nations with interests in the Plan Area are involved in treaty negotiations with the BC and federal governments: the Heiltsuk Tribal Council, the Oweekeno Nation, the Haisla, the Gitga'at, Kitasoo, the Homalco, and the Kwakiutl District Council. The treaty negotiation process is comprised of six stages and as of September 2000, none of the negotiations were past the "Agreement in Principle" stage, which is the most complex and time-consuming part of the process.

2.3.4 Outlook

The provincial government's position is that LRMPs are without prejudice to aboriginal land claims; moreover, LRMPs are about how lands/resources are managed, not about ownership. However, the claims process is relevant to the LCRMP in that it is yet another factor that will eventually impact land use and the local/provincial economy in the Base Case. The eventual outcome of treaty negotiations should have net positive economic implications for the Plan Area, as well as contributing to greater self-sufficiency for local First Nations. This observation is based primarily on expectations of monetary inflows from the federal government for claims settlements, as well as on the implications of potential increases in local control of resources (e.g., timber lands). As well, land use certainty for aboriginals and non-aboriginals should be strengthened, as well as business relationships between First Nations and other local interests.

However, there could also be some negative affects to some individuals (mainly non-Plan Area residents) for a period of time if lesser amounts of certain resources are available for use by non-aboriginals.

While not meant to imply anything specific about future land claims settlements in the Plan Area, for illustrative purposes, in the Nisga'a agreement, the transfer of 200,000 hectares of land (not all of it forested) results in a transfer of 155,000 m3/yr. of Allowable Annual Cut (AAC) to the Nisga'a, equivalent to about 10% of the Kalum Forest District AAC and 1%-2% of the AAC in the Prince Rupert Forest Region. To reiterate, while the terms of other treaties in BC may be much different for those of the Nisga'a deal, it is still relevant to document the details of that agreement from a timber perspective:[6]

- to ease transition, former tenure holders are apportioned temporary harvesting rights on Nisga'a lands totalling at least 125,000 m3/yr., to expire during an initial five-year transition period, after which time the Nisga'a obtain all the harvesting rights
- during the transition period, tenure holders must use Nisga'a contractors, if available, for 50% of the logging in the first year and 70% in years two through five
- the Nisga'a are not permitted to establish primary sawmilling facilities for 10 years
- the Nisga'a are entitled to collect stumpage for timber harvested on Nisga'a land

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[5] It is important to recognize that various First Nations (and even groups within individual First Nations) may have different ideas on land and resource use, notwithstanding the fact that some live in close proximity to one another.

[6] Information excerpted from *Nisga'a Final Agreement - Forestry Implications*: Davis & Co., November 1998.

- the FPC does not apply on Nisga'a lands, but forestry standards must meet the FPC

Therefore, impacts to existing processing facilities should be minimal for the first five years, and after that, the implications depend on the willingness of the Nisga'a to harvest and market the timber on their lands. However, work for some non-Nisga'a logging contractors in the Terrace area could diminish soon after the agreement comes into affect.

As a related issue, the implications of the 1997 Delgamuukw ruling by the Supreme Court of Canada are likely to have far-reaching implications for BC residents.[7] In effect, the ruling stated that First Nations have extensive and constitutionally protected communal property rights (individuals are not deemed to hold title) to lands, and not just the right to use land for traditional purposes; however, such lands cannot be used for a purpose inconsistent with their traditional relationship with the land (e.g., it could not be strip-mined if that would destroy their cultural relationship with the land.) The ruling also indicates that aboriginal title also means that the owners can exclude others from the property, extract resources from it, and use it for business and pleasure.

Although First Nations maintain that they hold title to a significant portion of the Plan Area, it is not yet known exactly where future title exists, as that is to be decided either through treaty negotiations or future court decisions. Essentially, on any given tract of land, First Nations will have to prove that they occupied the land to the exclusion of others before 1846 (the year Britain declared sovereignty over the area that became BC) and that there has been some degree of continuity in that occupation until the present.

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[7] This discussion is summarized from *A Lay Person's Guide to Delgamuukw*: BC Treaty Commission Annual Report, 1997-98.

3. ECONOMIC STRUCTURE

3.1 Resident Labour Force and Employment

Natural resource activities, primarily fishing, forestry, hunting, and trapping, have traditionally been the economic mainstay of the Plan Area, both for commercial and subsistence purposes. However, with minimal forest product processing, the gradual closures of the once-numerous fish processing facilities, the dismantling of the Ocean Falls pulp mill in 1980, and the mid-to-late 1990s downturns in the fishing and forest industries, the local economy has experienced its share of difficulties. However, between 1986 and 1996 economic and population growth was relatively strong for such a sparsely populated area, in spite of the Plan Area's relative remoteness, minimal infrastructure, and lack of economic diversification..

Labour force estimates reveal the underlying structure of the regional economy. The 1986, 1991, and 1996 Census labour force estimates by sector for the Plan Area are shown in Table 6. Note that this data consists of numbers of workers (not Person-Years) living in the Plan Area, includes both the employed and unemployed (although one must have been employed at some point during the 18 months prior to the Census to be counted) and it allocates workers based on their primary livelihood. Therefore the estimates do not account well for the contribution of part-time and secondary/seasonal activities.

The apparent trends and conclusions arising from the data in Table 6 (next page) are:

- From 1986-1996, the total Plan Area resident labour force grew by 38% (vs. 28% for BC overall), largely due to growth in private and public sector services
- Over 90% of the roughly 2200-member labour force is located in the northern portion of the Plan Area; between 1986 and 1996, the labour force in the north grew by about 40%, while that in the south remained relatively stable.
- For the two most significant resource sectors, as of 1996 the number of direct forestry workers (primary & manufacturing) is estimated at 325 (15% of the resident labour force) and direct fishing (primary & manufacturing) is estimated at about 200 (approximately 11% of the resident labour force)
- Employment in these resource sectors has been much more volatile (reflecting both cyclical and structural changes) than that in the service sector, which has demonstrated consistent growth from 1986-1996; for example, from 1991 to 1996, fishing-related manufacturing jobs declined by about 70% in the northern portion of the Plan Area, due to closures of fish plants at Namu and Shearwater
- From 1986 to 1996, the proportion of the labour force in the "Goods-Producing Sector" (i.e. primary and manufacturing) declined from 36% to 31% , while the "Services Sector" grew from 64% to 69% - this trend is consistent with most other BC regions
- In 1996, the Public Sector (i.e., government, health, and education) alone was a larger employer than the entire Goods-Producing Sector

Table 6: Number of Workers in Central Coast Plan Area Resident Labour Force*
(includes employed & unemployed)

	1986			1991			1996			% change 1986-96
Industry Sector	**North**	**South**	**Total**	**North**	**South**	**Total**	**North**	**South**	**Total**	**Plan Area**
Primary										
Logging & Forestry	215	40	**255**	170	20	**190**	270	20	**290**	
Fishing & Trapping	150	15	**165**	135	25	**160**	170	30	**200**	
Agriculture	40	5	**45**	10	0	**10**	40	0	**40**	
Mining	5	0	**5**	0	0	**0**	0	0	**0**	
Sub Total	410	60	**470**	315	45	**360**	480	50	**530**	+13%
Manufacturing										
Fish & Food	breakdown unknown			280	n/a	**280**	75	10	**85**	
Sawmill, Planing, etc.	breakdown unknown			45	n/a	**45**	30	5	**35**	
Other Manufacturing	breakdown unknown			25	n/a	**25**	20	5	**25**	
Sub Total	100	10	**110**	350	10	**360**	125	20	**145**	+32%
Services										
Retail /Wholesale Trade	150	5	**155**	180	10	**190**	215	10	**225**	
Real Estate/Finance	5	0	**5**	20	0	**20**	10	5	**15**	
Accom./Food/ Beverage	110	25	**135**	115	30	**145**	155	15	**170**	
Construction	50	10	**60**	90	10	**100**	110	10	**120**	
Communications/ Utilities	35	5	**40**	50	0	**50**	50	0	**50**	
Transportation/ Storage	60	5	**65**	85	0	**85**	70	10	**80**	
Other Services	65	0	**65**	75	0	**75**	100	10	**110**	
Sub Total	475	50	**525**	615	50	**665**	710	60	**770**	+47%
Public Sector Services										
Government	195	20	**215**	275	35	**310**	320	20	**340**	
Education	160	10	**170**	185	10	**195**	225	15	**240**	
Health /Social	95	5	**100**	85	0	**85**	155	10	**165**	
Sub Total	450	35	**485**	545	45	**590**	700	45	**745**	+54%
Total	**1435**	**155**	**1590**	**1825**	**150**	**1975**	**2015**	**175**	**2190**	**+38%**
% of Total Plan Area	**90%**	**10%**	**100%**	**92%**	**8%**	**100%**	**92%**	**8%**	**100%**	

Source: *1986, 1991, & 1996 Census*: Statistics Canada. Note data also includes on-reserve labour force.

* Census makes no distinction made between full-time vs. part time workers, classifies workers based on their reported primary job, & includes all who worked at some point in the 18 months prior to Census day.

Table 7 provides labour force estimates for native reserves only. Key observations from this data are:

- 49% (1070 of 2190 workers) of the overall Plan Area resident labour force live on-reserve
- The pubic sector is the single largest source of labour force activity for those on-reserve
- About 14% of the on-reserve labour force had some association with forest sector in 1996
- About 19% of the on-reserve labour force were associated with fishing/processing in 1996

Again, it is noted that labour force data includes both employed and unemployed, and given the anecdotal evidence that unemployment among First Nations is extremely high in the Plan Area, exacerbated by the seasonal nature of much of the work that is available, it is very likely that far less than 1070 Plan Area aboriginals have full-time, year round employment. This is supported by Revenue Canada data (see Appendix B) for the Central Coast Regional District, for which the 1996 average income per tax return was $18,363 vs. $27,767 for BC. The median income measure (i.e., the income level where half the population earns more and half earns less) shows an even wider variation: $11,719 in the Central Coast vs. $19,834 for BC.

The Central Coast region is rich in resources, however a low proportion of both the extraction and processing jobs actually accrue to the local residents. This situation is due mainly to centralization (for economic reasons) of fish and forest product processing elsewhere in BC and the area's proximity to larger communities outside of the region (e.g. Campbell River, Port Hardy). A significant proportion of residents, especially youth and First Nations, experience high unemployment characterized by seasonal fluctuations. Limited employment opportunities exist, which also discourages young people from remaining in the area.

Table 7: 1996 Resident Labour Force Estimates for Native Reserves in the Plan Area*
(includes employed & unemployed)

Sector	1996 Labour Force on Native Reserves			% of Total Reserve Labour Force
	North	South	Total	
Primary				
Logging & Forestry	75	5	80	
Fishing/Trapping/Aquaculture	135	10	145	
Agriculture	10	0	10	
Mining	0	0	0	
Sub Total	220	15	235	22%
Manufacturing				
Fish/Food Processing	65	5	70	
Sawmills/Planing/etc.	10	0	10	
Other Manufacturing	5	0	5	
Sub Total	80	5	85	8%
Services				
Retail/Wholesale Trade	95	5	100	
Real Estate/Finance/Insurance	0	0	0	
Accommodation/Food	55	0	55	
Construction	35	0	35	
Communications/Utilities	15	0	15	
Transportation/Storage	20	0	20	
Other Services	35	5	40	
Sub Total	255	10	265	25%
Public Sector Services				
Government	240	20	260	
Education	130	5	135	
Health /Social	85	5	90	
Sub Total	455	30	485	45%
Total	**1010**	**60**	**1070**	**100%**

Source: 1996 Census, Statistics Canada.

* Census makes no distinction made between full-time vs. part time & includes those who worked at some point in the 18 months prior to Census day.

According to Table 8, the unemployment rate in the overall Plan Area declined from 25% to 15% over the 1986 to 1996 term, reflecting the slow recovery from the economic recession in the early 1980s. However, unemployment appeared to worsen in the southern portion during this period. Both areas also experienced much higher unemployment rates than the 1996 BC average of 8.9%. Moreover, since 1996, the local employment situation has deteriorated, primarily due to declines in the fishing and forestry sectors. First Nations in the Plan Area also are reported to experience much higher unemployment rates, in some cases well in excess of 50%.

Table 8: Central Coast Plan Area Labour Force, Employment, and Unemployment

	1986			1991			1996		
	North	**South**	**Total**	**North**	**South**	**Total**	**North**	**South**	**Total**
Employed	1,135	130	1,265	1,465	125	1,590	1,610	140	1,750
Unemployed	410	20	430	370	20	390	285	30	315
Total Labour Force	**1,550**	**150**	**1,700**	**1,825**	**160**	**1,985**	**1,895**	**170**	**2,065**
Unemployment Rate	**27%**	**13%**	**25%**	**20%**	**13%**	**20%**	**15%**	**18%**	**15%**

Source: 1986, 1991, & 1996 Census, Statistics Canada.

Additional social and economic statistics for the Central Coast Regional District (which closely approximates the northern portion of the Plan Area, home to over 90% of Plan Area residents) are contained in Appendix B.

3.2 Sectoral Economic Dependencies

Labour force data do not identify the driving forces behind a regional economy (commonly termed the "basic sectors") nor are tourism or non-employment sources of income (e.g., pensions, investments, etc.) accounted for. Utilizing Census labour force and other data, the Ministry of Finance and Corporate Relations (MFCR) has undertaken an "economic dependency analysis" for all regions in BC in order to better define the economic structure of local areas and communities. Note that this analysis does not account for subsistence activities (e.g., fishing and hunting) of First Nations or others, which are acknowledged to often be an important component of overall socio-economic well-being in rural areas.

Table 9 illustrates the degree to which area residents were, in 1996 (the latest available year) dependent on various sectors for employment/income in the Mid Coast Forest District, which approximates the northern portion of the Plan Area and accounts for over 90% of its labour force/employment.[8]

The analysis clearly demonstrates that forestry, the public sector, tourism and fishing activities dominate the local economy. It is noteworthy that the contribution of the public sector (including salaries of government employees and transfer payments) was 45% of the total basic income in 1996, more than double that of the next largest sector (i.e., forestry) - this adds considerably to the economic stability in the area, although it is acknowledged that the Plan Area is still subject to more severe economic fluctuations than most other regions of BC. (Note that the MFCR economic dependency model considers government salaries and transfer payments to be basic income not because they generate wealth, but because at the regional level, incomes from government sources are determined primarily by forces outside of the region.)

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[8] MFCR divides employment and income into "basic" and "non-basic" sectors. The basic sectors are those which result in personal income flowing into the area from other regions and are considered to be the "drivers" of the local economy, e.g., forestry, tourism, public sector incomes, etc. Non-basic sectors are assumed to exist due to spending of basic sectors.

Table 9: 1996 Mid-Coast Forest District Resident Employment and Income Dependencies

Industry / Sector	Basic Employment Dependencies	Basic After-Tax Income Dependencies
Public Sector	39%	37%
Forestry	21%	26%
Tourism /Business Travel	16%	10%
Fishing/Trapping/Aquaculture	14%	8%
Other	8%	6%
Government Transfer Payments	-	8%
Other Investment Income & Private Pensions	-	4%
Agriculture	2%	1%
Mining	0%	0%
Total of Basic Sectors	**100% (1,861)**	**100% ($34.9 Mill.)**
Total of Non-Basic Sectors	160	$2.2 Mill.
Total Employment & Income	**2,020**	**$37.1 Mill.**

Source: *The 1996 Forest District Tables*: Ministry of Finance and Corporate Relations (Unpublished), April 1999.
* Includes construction, parts of manufacturing & transportation, etc. not allocated to other industries.

Given the significant economic linkages with northern Vancouver Island, Table 10 is included for information purposes to illustrate the structure of that area, comprised of the Pt. McNeill and Campbell River Forest Districts (i.e., from the Courtenay and Gold River areas northward, along with relatively unpopulated areas of the Central Coast comprising the southern portion of the Plan Area.) Noteworthy observations from this information are the high degree of dependence of the Pt. McNeill Forest District on forestry (i.e., 47% of Basic Income), which is contrasted by the relatively significant dependency of the Campbell River Forest District on non-resource industry income (i.e., 42% from public sector salaries, investment income, and transfer payments to individuals.)

Table 10: 1996 Campbell River & Port McNeill Forest District Employment/Income Dependencies

Industry/Sector	Basic Employment Dependencies		Basic After-Tax Income Dependencies	
	Campbell R. FD	**Pt. McNeill FD**	**Campbell R. FD**	**Pt. McNeill FD**
Forestry	23%	39%	23%	47%
Mining	4%	4%	3%	5%
Fishing/Trapping/Aquaculture	6%	11%	3%	7%
Agriculture	3%	1%	1%	1%
Tourism/Business Travel	17%	15%	7%	7%
Public Sector	31%	23%	23%	18%
Other	16%	7%	11%	4%
Govt. Transfer Payments	-	-	17%	8%
Investments, Priv. Pensions	-	-	12%	4%
Total	**100%**	**100%**	**100%**	**100%**

Source: *The 1996 Forest District Tables*: Ministry of Finance and Corporate Relations (Unpublished), April 1999.
* Includes construction, parts of manufacturing & transportation, etc. not allocated to other sectors.

3.3 Economic Linkages between Plan Area & other Regions

Many individuals and communities outside of the Central Coast Plan Area benefit from activities that occur within the area. As noted previously, the most closely-linked are the communities on mid and northern and Vancouver Island, but communities in the Cariboo-Chilcotin (including Williams Lake), Prince Rupert, Kitimat, southern Vancouver Island, and the Lower Mainland also benefit from the Plan Area's resources and expenditures by businesses/individuals working in the Central Coast.

3.3.1 Expenditures by Resource Industries

Due to the lack of suitable road access into most of the Plan Area, marine and air transportation tends to be the preferred means of transporting specialized supplies and services to many of its communties. Many living outside the Plan Area benefit from such expenditures made by the local logging, commercial fishing, aquaculture and tourism industries.

For example, the forest industry spends large amounts on mechanical services and supplies, aircraft and marine transportation, road construction materials, wire rope, camp supplies, etc. Similarly, the fishing and aquaculture industries purchase fuel, equipment, net repair services, fish feed, and related supplies, generally from businesses located outside the Plan Area (e.g., Port Hardy, Campbell River, etc.) Many of the large tourism operators (e.g., sport fishing lodges) also purchase fishing equipment, food and beverages, accommodation supplies, and other hospitality-related goods from outside sources.

3.3.2 Non-Resident Employment & Income

The majority of the employment generated by the area's resource and tourism sectors accrues to workers who reside outside of the Plan Area. For example, in the case of the forest sector, virtually all of the approximately four million m3/yr of Plan Area AAC is processed elsewhere. As a result, about 96% of the approximately 4400 workers (including those employed in pulp and paper mills) supported by this harvest reside outside the Plan Area, with as many as one-third residing from Campbell River northward on nearby Vancouver Island. Using 1997 wood flow information provided by the two tenure holders representing about two-thirds of the Plan Area's average annual harvest, Table 11 shows the approximate destination of much of the timber harvested from the Central Coast. Note that due to varying market conditions and other factors, these fibre flows are volatile and therefore will change over time.

Table 11: Estimated Flows of Interfor/Western Forest Products Logs from Plan Area

Destination	Volume
Port Alice	10%
Campbell River	1%
Powell River/Port Alberni	2%
Nanaimo	3%
Ladysmith	1%
Lower Mainland	66%
Cowichan	5%
Crofton	1%
Log Trades	11%
Total	**100%**

Source: International Forest Products Ltd. and Western Forest Products Ltd, 1997.

In the case of aquaculture, it is estimated that about 95% of the approximately 640 jobs the Plan Area are held by non-residents, mostly living mid-to-northern Vancouver Island. And for tourism, it appears that over half of the estimated 540 jobs generated in the Plan Area are held by workers living outside the Plan Area. An unknown portion (i.e., those in excess of the 285 estimated residents employed in the fisheries as of 1996) of the overall number of fish harvesting jobs associated with the Central Coast fishery are also held by non-residents, and certainly most of processing jobs are located outside of the Plan Area;[9] however, it is acknowledged that some Plan Area residents also catch fish in other areas of the BC coast.

Businesses operating in the Plan Area also purchase significant amounts of supplies and services from Vancouver Island and the South Coast because in many cases what is required is not available locally, or because it is less expensive than accessing them locally. However, it is understood that Bella Coola area merchants believe that more purchases could be made from local businesses. In summary, the current nature of economic dependency between communities within the Plan Area and outside communities is expected to continue into the foreseeable future, in the absence of any pro-active measures to alter this situation. A possible off-setting factor would be continued or increasing the amount of joint ventures/contracting with local First Nations and other Plan Area residents in sectors such as forestry, aquaculture, and tourism should there be the mutual will to do so.

3.4 Outlook

Since a large proportion of (resident and non-resident) jobs in the Plan Area are closely tied to fishing, forestry, tourism, and aquaculture, the best prospects for growth are within these sectors, although possibly taking different approaches than those that have characterized the past. This is largely because coastal timber supplies are expected to become even tighter in the future, even without LCRMP or new Protected Areas, and there is unlikely to be a return to the past levels of commercial salmon fishing in the foreseeable future. There is potential, though, for more local value-added wood processing, labour-intensive timber harvesting, and silviculture opportunities. For example, a local value-added manufacturer in Hagensborg has undergone a mill expansion that employs additional full-time workers. Also in the short term, there is a current proposal for an aggregate quarry / bottled water plant / port facility for Bella Coola that could create up to 59 direct jobs and last for several decades, according to the proponent.

Over the longer term, the tourism industry will likely see continued growth due to the significant outdoor (terrestrial and coastal) recreation resources of the Central Coast, as well as due to initiatives such as the introduction of BC Ferries Discovery Coast Passage Route into the north portion of the Plan Area. Harvesting of non-salmon fisheries could also increase, subject to sustainability constraints. Expansion of the salmon/shellfish aquaculture and offshore oil/gas industries may also provide longer term future employment growth, although there remains a provincial freeze on both salmon farming tenures and offshore petroleum development. Settlement of First Nations land claims settlements should eventually result in significant financial injections into the local economy. However, in summary, given the declining timber and fisheries stocks, low population, distance from markets and other infrastructure/logistical impediments, the Plan Area's economic growth will likely continue to be very modest for several years.

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[9] These worker residency statistics, which are derived/explained in Section 4 of this report, are not meant to imply anything about the "value" of resident vs. non-resident jobs. They are included for two main reasons: (i) Analysts are expected to address both regional and provincial-level impacts in LRMP socio-economic analysis as stipulated in the guidelines governing this work (see *Social and Economic Impact Assessment for LRMP in BC: Interim Guidelines*, Province of BC, 1993); and (ii) Such analysis tends to be of interest to those in planning processes where socio-economic interests are being discussed.

4. SECTOR REVIEW & OUTLOOK

4.1 Forestry

4.1.1 Background

Forestry is the largest private sector source of employment in the Plan Area, and as of 1996, accounted for an estimated 26% of the personal income (see Table 9) of Mid-Coast Forest District residents, where over 90% of the Plan Area population resides. Most of the productive coastal forests are located at low to medium elevations and are dominated by western hemlock, western red cedar and Douglas-fir. Hemlock, fir and, to a lesser extent, yellow cedar, dominate the coastal sub-alpine forests. Typically harvesting operations in coastal areas employ cable-yarding systems, such as the high-lead tower and grapple yarders, while heli-logging is suited to harvest areas that may not be harvested using conventional techniques due to economic or environmental concerns.

From an administrative perspective, Plan Area covers a relatively large and complex region of the BC coast. It covers a Gross Land Base (GLB) of approximately 4.8 million hectares, including all of the Mid-Coast Forest District (including the southwest and central portion of Tweedsmuir Park), and the mainland portions of the Port McNeill and Campbell River Forest Districts and most of the islands north of Quadra Island, along with a relatively small part of the North Coast Forest District. In terms of Ministry of Forests (MoF) Timber Supply Areas (TSAs) and Tree Farm Licenses (TFLs), the Plan Area encompasses the Mid-Coast TSA, the mainland portions of the Kingcome and Strathcona TSAs, about 8% of the North Coast TSA, and several TFLs, as shown in Map 2. This map also illustrates the 10.7% of Plan Area in existing fully/partly Protected Areas (including the Hakai and Fiordland Recreation Areas, which allow mining but not logging) and the 6.7% of the area proposed by the provincial government as "Cabinet-Approved Study Areas" for consideration by the LCRMP Table as additional Protected Areas (some with a marine component).

4.1.2 Base Case Timber Harvesting Constraints and Zones

MoF forest cover constraints are applicable at all times to all areas within the Plan Area, over and above requirements that may be applied to specific areas or forest types to account for management of deer winter range, grizzly bears, scenic values or community watersheds. The following "general" constraints occur within the TSAs and TFLs in the Plan Area:[10]

Cutblock adjacency – requirement is expressed as a maximum percent of the timber harvesting land base in any landscape unit may be covered by stands less than 3 meters. In all TSAs/TFLs this is modeled as a maximum of 33% of the Timber Harvest Land Base (THLB). The estimated growing years required to achieve a 3 meter height is 12 to 15 years depending on forest growth rates in the area.

Landscape level biodiversity – It is generally assumed for analysis purposes that 45% of each management unit (TSA or TFL) will be managed with "low biodiversity emphasis," 45% will be managed for "intermediate biodiversity," and 10% will be managed for "high biodiversity" under the guidelines of the FPC, including the recent *Landscape Unit Planning Guide* (1999). The entire area within all TSAs/TFLs in the Plan Area will be managed under one of the following biodiversity emphasis categories:

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[10] Myles Mana, MoF Timber Supply Analyst, Vancouver Forest Region: *pers. comm.*

- ⇒ ***Low biodiversity*** – for the first timber rotation, a minimum of 4% of the forested area of each biogeoclimatic variant within each landscape unit must be within stands older than 250 years. In the second timber rotation this requirement increases to require a minimum of 9% old growth within each landscape unit and variant, and in the third timber rotation a minimum of 13% old growth is required.
- ⇒ ***Intermediate biodiversity*** - a minimum of 13% of the forested area of each biogeoclimatic variant within each landscape unit must be within stands older than 250 years.
- ⇒ ***High biodiversity*** - a minimum of 19% of the forested area of each biogeoclimatic variant within each landscape unit must be within stands older than 250 years.

There are also additional forest cover requirements applied to smaller, specific areas within TSAs/TFLs that are also not mutually exclusive (i.e., the same area of forest may be subject to many or even all of the following requirements, as well as the above requirements):

Scenic Areas – Where the visual quality class calls for "retention" of scenic values is modeled by limiting the forested area that may be occupied by stands less than 5 meters tall to a maximum of 5% at any time. In areas where "partial retention" of visual quality is the objective, the maximum percentage is increased to 10% and in areas where visual quality objectives allow "modification" of scenic values, the percentage is increased to 20%. (Note: In practice, the actual percentage of stands less than 5 meters tall will vary somewhat from the modeled percentages listed above, as the latter are intended to represent "average" management for each visual quality class.)

Community Watersheds (Mid Coast TSA only) – within community watersheds, the rate of harvest is limited to a maximum of 5% of the forest area within any five year period. Only the Mid Coast TSA has community watersheds included in the "base case" timber supply forecast.

Deer Winter Range - for all TSAs/TFLs except the Mid Coast TSA, high value wildlife habitat that is mapped on the forest cover maps (environmentally sensitive areas coding) is excluded from the THLB. For the Mid Coast TSA, management for deer winter range is modeled by requiring that 25% of the forest area (within specific forest cover types known to provide quality deer winter range) is maintained in stands older than 250 years.

Grizzly Bear Habitat (Mid Coast TSA only) – The amount of forested area mapped as suitable grizzly habitat (1988 mapping) will be maintained in perpetuity in the same drainages (general location) and forest types. This works out to approximately 13% of the THLB in these drainages/forest types being maintained in stands older than 250 years.

Therefore, it is important to understand that in the Base Case management regime, harvesting constraints are not identical throughout the entire THLB, i.e., some areas are "specially managed" due to such initiatives as Visual Quality Objective (VQO) zones and sensitive wildlife habitat. In addition to these Base Case "Additional Constraint Zones" (ACZs), in the absence of the LCRMP most of the remainder of the Plan Area would be designated as some form of "General Management Zone" (GMZ) that would operate under minimum FPC requirements. Table 12 indicates the breakdown of both the North and South portions of the Plan Area by these zones, although the Grizzly, Deer, and Community Watershed zones are subsumed under "General Management;" Map 3, which depicts Base Case land use, does show Community Watersheds and Grizzly Habitat Areas, however. These zones form the basis for the "Base Case" land use regime assumed to occur in the absence of a land/coastal use plan both for the socio-economic and environmental components of this report.

Table 12: Base Case Zones in the Plan Area
by Gross Land Base (GLB) and Timber Harvesting Land Base (THLB)

	North Portion			South Portion	
Base Case Land Use Zone	**GLB**	**THLB**		**GLB**	**THLB**
General Management	69%	80%		90%	77%
Preservation/Retention VQOs	3%	4%		1%	2%
Partial Retention VQOs	8%	14%		7%	20%
Deferrals re 1st Nations Issues	2%	2%		0%	0%
Existing Recreation Areas	4%	0%		0%	0%
Existing Protected Areas	13%	0%		0%	0%
Total ('000 hectares)	**2,952**	**222**		**1,672**	**329**

Source: Ministry of Forests, Vancouver Forest Region.

Zone Definitions:

- ⇒ ***Preservation VQO***: 0-1% of forested area can be <5m in height at any time.
- ⇒ ***Retention VQO***: 1%-5% of forested area can be <5m in height at any time.
- ⇒ ***Partial Retention VQO***: 6%-10% of forested area can be <5m in height at any time.
- ⇒ ***Deferrals***: Areas deferred from timber harvesting due to First Nations issues.
- ⇒ ***Recreation Areas***: Partially protected areas that allow mining activities, but not timber harvesting.
- ⇒ ***Protected Areas***: Areas where no industrial activities (e.g., logging and mining) are permitted.
- ⇒ ***General Management:*** Remaining land base, managed under minimum FPC requirements.

4.1.3 The Timber Harvesting Land Base, Harvest Levels, and Forest Tenures

Table 13 contains a north/south split of various relevant THLB statistics (inclusive of TFL lands) and also indicates the age classes and timber productivity of the forest in the Plan Area.

Table 13: Current Age Class and Site Productivity* of the Timber Harvesting Land Base

	North THLB			South THLB	
Age Class	Area (thousand ha.)	Volume (million m3)		Area (thousand ha.)	Volume (million m3)
Old Growth (>251 yrs.)	137	91		96	64
Mature (81-250 yrs.)	36	20		53	24
Mid-Seral (41-80 yrs.)	5	1		78	25
Early Seral (<40 yrs.)	44	1		102	3
Total THLB	**222**	**113**		**329**	**116**
Site Productivity*					
Good (>25)	11	-		67	-
Moderate (20-25)	115	-		160	-
Poor (15-20)	96	-		102	-
Total THLB	**222**	-		**329**	-

Source: Ministry of Forests, Vancouver Forest Region.

Note: These THLB estimates do not contain net-downs for the Forest Practices Code (e.g., riparian areas) or for roads.

*Site productivity indicates the more productive growing sites; e.g., an estimate of 25 means that trees would grow to 25 metres after 50 years.

Overall, these statistics indicate that about 551,000 ha. (or 11.9% of the overall Plan Area, net of water) is designated as "Timber Harvesting Land Base" (THLB), i.e., area that is available and deemed economically feasible for timber harvesting in the short and long term. In the North, 7.5% of the GLB is considered THLB, and 19.7% is THLB in the South.[11] The THLB is shown in Map 4.

These THLB estimates are much smaller than the GLB area because much of the GLB is non-forested/inoperable (i.e., mainly rock, ice, alpine, steep terrain, problem forest types, etc.), due to "net-downs" for environmental values (e.g., existing Parks, riparian reserves, etc.), and since some land is non-Crown. However, as economics and/or technology improve, the THLB could expand into currently inoperable areas. Table 14 shows the extent to which various age classes of timber exist throughout the Gross Land Base (GLB) of the entire Plan Area, inclusive of the THLB. When compared with Table 13, the data also shows that there is a significant amount of old growth existing outside of the THLB.

Table 14: Current Age Class of Timber on Gross Land Base (GLB)

	North GLB			**South GLB**	
Age Class	Area (thousand ha.)	Volume (million m3)		Area (thousand ha.)	Volume (million m3)
Old Growth (>251 yrs.)	1062	332		431	187
Mature (81-250 yrs.)	70	7		122	36
Mid-Seral (41-80 yrs.)	463	122		186	63
Early Seral (<40 yrs.)	1356	1		932	4
Total GLB	**2951**	**462**		**1671**	**290**

Source: Ministry of Forests, Vancouver Forest Region.

Table 15 contains the same type of data as Table 13, but only for the Plan Area's Cabinet-approved "Study Areas," which can be thought of as candidate Protected Areas and are deferred from timber harvesting pending LCRMP decisions (see Map 5). It is apparent that 16% (17.4 million m3) of THLB mature/old growth volume (a relevant indicator from a short-term timber supply perspective) in the north portion of the Plan Area is in these areas, with the southern proportion being 6% (5.3 million m3).

Table 15: Current Age Class & Site Productivity* of the THLB in Cabinet-Approved Study Areas

	North THLB			**South THLB**	
Age Class	Area (thousand ha.)	Volume (million m3)		Area (thousand ha.)	Volume (million m3)
Old Growth (>251 yrs.)	23.3	15.2		5.7	3.9
Mature (81-250 yrs.)	3.9	2.2		2.1	1.4
Mid-Seral (41-80 yrs.)	0.1	0.02		1.7	0.5
Early Seral (<40 yrs.)	1.4	0.03		1.5	0.05
Total THLB in SAs	**28.7**	**17.4**		**11.0**	**5.8**
Site Productivity*					
Good (>25)	2.0	-		1.2	-
Moderate (20-25)	18.5	-		4.4	-
Poor (15-20)	8.2	-		5.4	-
Total THLB in SAs	**28.7**	-		**11.0**	-

Source: Ministry of Forests, Vancouver Forest Region.

*Site productivity indicates the more productive growing sites; e.g., an estimate of 25 means that trees would grow to 25 metres after 50 years; for detail on individual Study Areas, see **Appendix D.**

The total AAC of the Central Coast LCRMP area is approximately four million m3/yr. Forest licenses within TSAs account for about 65% of the AAC whereas TFLs make up the remaining 35%. Table 16 presents the distribution of recent average annual harvest levels by licensee within the Plan Area. The estimated TSA AAC apportionments (i.e., excluding TFLs) in each of the Forest Districts in the Central Coast Plan Area are presented in Table 17.

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[11] It understood that FPC net-downs have not been taken into account in these THLB estimates.

Table 16: 1996 Harvest in the Central Coast Plan Area by Operator

Company	Volume (m³/yr.)	Share (%)
International Forest Products	1,516,000	43%
Doman Industries / Doman Western	869,000	24%
Weyerhaeuser	455,000	13%
Timberwest	425,000	12%
Shushartie Log Sales (Mill & Timber)	166,000	5%
Little Valley Forest Products	64,000	2%
SWC Holdings Ltd.	23,000	0.5%
Coast Mountain Hardwoods	20,000	0.5%
Scott Paper	14,000	0.4%
West Fraser	5,000	0.1%
Total 1996 Harvest*	**3,557,000**	**100%**

Source: Forest Licensees.

***Notes:** (1) Licensees are not required to cut the exact AAC each year & (2) Excludes Small Business harvest since no mainland/Vancouver Island breakdown available.

Table 17: Central Coast Plan Area TSA AACs & other Non-TFL Harvests

Type of License	Mid Coast TSA	Pt. McNeill TSA	Campbell R. TSA	North Coast TSA	Total Plan Area
	(m³/yr.)	(m³/yr.)	(m³/yr.)	(m³/yr.)	(m³/yr.)
Forest Licenses, Replaceable	869,221	726,000	100,000	30,000*	1,725,221
Timber Sale Licenses	2,552	10,000	12,000		24,552
Small Business Program	82,477	235,000	85,000		402,477
Forest Service Reserves	23,294	10,000			33,294
Woodlot Licenses	4,912	2,500	500		7,912
Forest Licenses, Non-replaceable	17,544	112,000			129,544
Non-TSA/TFL Volume Harvested**	200,000	75,000	25,000		300,000
Total	**1,200,000**	**1,170,500**	**222,500**	**30,000**	**2,623,000**

Source: Ministry of Forests Regional & District Staff.

* Estimate based on % of TSA THLB in Plan Area.; the short-term harvest in that part of the North Coast TSA in the Plan Area is actually expected to be ~126,000 over the next several years, however.

** Additional volume is harvested primarily from "Timber Licenses," a form of tenure that is area-based and gives the holder the one-time right to harvest all of the mature timber, after which the area reverts to the Crown; TLs are not part of TSAs/TFLs, there is no AAC, and annual harvest levels are difficult to predict.

Within the Mid Coast Forest District, the major tenures are held by Doman (includes part of TFL #25), Weyerhaeuser (includes part of TFL #39), and International Forest Products (Interfor). Interfor (includes TFL #45), Weyerhaeuser (including part of TFL #39), Timberwest (including part of TFL #47) and Shushartie Logs Sales Ltd. (and its parent company Mill & Timber Products Ltd.), are the larger Licensees on the mainland portion of the Port McNeill Forest District, while Timberwest (including part of TFL #47), Doman (including part of TFL #25), Weyerhaeuser (including part of TFL #39), and Interfor tenures are located in the mainland portion of the Campbell River Forest District. Part of a West Fraser tenure is also located in that portion of the Plan Area that extends into the North Coast TSA.

As noted, there are several TFLs in the Plan Area. The significance of TFLs is that they assign "area-based" tenure for timber to specific Licensees for long periods of time, and therefore provide a higher level of certainty to the operator. Alternatively, TSA operating areas are "volume-based" and therefore change in location as harvesting proceeds over time, with no long term harvesting rights over specific areas. The current AACs and contribution to the overall Plan Area harvest of these TFLs are presented in Table 18.

Table 18: Harvest Allocations of Tree Farm License (TFL) Lands the Plan Area

Licensee	TFL #	Total 1996 TFL AAC (m3/yr.)	Estimated Amount in Plan Area (m3/yr.)
Weyerhaeuser	39	3,740,000	405,000
Timberwest	47	865,000	425,000
Doman Industries	25	779,000	347,000
International Forest Products	45	220,000	220,000
Scott Paper	43	44,460	6,000
Total	-	-	**1,403,000**

Source: Ministry of Forests and Licensee estimates.

4.1.4 Employment

As noted earlier, the forest sector contributes more private sector employment/income to the Plan Area than any other economic activity. The amount, nature, and distribution of this employment is driven by the fact that over 95% of the AAC is harvested by Licensees (generally operating from logging camps) who do not have processing facilities in the Plan Area. As a result, most of this timber is transported to processing facilities on Vancouver Island and the Lower Mainland. For example, the solid wood processing facilities of the four largest tenure holders in the Plan Area (collectively accounting for 92% of the harvest) rely on the Central Coast for about 52% (Interfor), 44% (Doman), 21% (Timberwest), and 8% (Weyerhaeuser) of their respective overall annual harvests. Doman's Central Coast harvesting operations also supply a portion of the needs of its pulp mill in Port Alice and, indirectly via residual chips, its Squamish pulp mill. Weyerhaeuser also utilizes fibre from its Central Coast operations to supply pulp & paper mills owned by other companies in Pt. Alberni, Powell River, and Nanaimo. Interfor and Timberwest do not own any pulp mills, but both supply Central Coast-generated chips and/or logs to the Vancouver Island/Coastal pulp industry, including the Fletcher Challenge Elk Falls pulp/paper mill in Campbell River.

Table 19 shows the distribution of overall forestry employment estimated to be linked to the 3.6 million m3/yr. recent harvest level by type and by residence.[12] Of the approximately 4400 Person-Years (PYs) of forestry employment that are (to a greater or lesser extent) estimated to be linked to the Central Coast harvest, it is evident that only about 5% of the workers reside in the Plan Area, although some licensees are hiring more local First Nations personnel. Excluding pulp & paper employment, a further 33% reside on northern and mid Vancouver Island (from the Campbell River area northward), testifying to the strong economic relationship this area has with the Central Coast forest sector. The majority of the remaining employees reside on southern Vancouver Island and the Lower Mainland. Note that these employment estimates refer to direct jobs only, not indirect jobs (i.e., jobs resulting from industry purchases of goods and services) or induced jobs (i.e., jobs resulting from the spending of industry direct and indirect employment income).[13]

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[12] Employment data was collected by the Ministry of Employment & Investment in 1998-99 by undertaking a direct survey of the Licensees. Since sawmills located outside the Plan Area have many fibre sources, employment in those mills was pro-rated by the percentage of fibre received from the Central Coast. Pulp & paper employment was not collected due to fibre flow complexities, but estimated on the basis of 0.28 Person-Years of employment per 1000 m3/yr., i.e., as 7097 PYs (less 410 due to Bowater closing) divided by Vancouver Forest Region 1995 harvest of 24,270,000 m3/yr reported in Pierce Lefebvre Consulting, *Analysis of Woodflows in the Vancouver Forest Region*, 1996.

Table 19: Recent Plan Area Forestry Employment in Person-Years (PYs)

Location of Worker Residence	Admin	Woodlands	Silviculture	Wood Processing*	Pulp & Paper (P/P)	Total	% with P/P	% w/o P/P
Plan Area	36	117	9	7	n/a	169	4%	5%
N. Coast	10	56	4	0	n/a	70	2%	2%
N. Island	66	124	9	43	n/a	242	6%	7%
Mid Island	99	628	40	100	n/a	867	20%	26%
S. Island	46	289	34	229	n/a	598	14%	18%
L. Mainland	56	278	20	908	n/a	1262	29%	37%
Unknown	3	66	8	100	996**	1173	27%	5%
Total	**316**	**1558**	**124**	**1387**	**996**	**4381**	**100%**	**100%**

Source: Direct survey of Forest Licensees by the Ministry of Employment & Investment.
Note: These estimates are in Person-Years (180 days of work assumed to be equal to one PY) and do not include any unemployed - they are thus not directly comparable to the labour force data in Table 6.
*Includes remanufacturing/value-added, of which there were less than 50 jobs reported in the survey, although the actual total is likely larger.
**Pulp/paper jobs would be located primarily on mid to southern Vancouver Island and the Lower Mainland.

Of all the types of forestry employment, woodlands (i.e., log harvesting/road-building/transportation) jobs are assumed to be most closely linked to the volume of timber extracted, followed by primary breakdown. The other forestry sub-sectors are assumed to be less strongly linked due to the availability of alternative supply sources (e.g., for pulp & paper) or because of the relative importance of other causal variables such as costs, markets, corporate decisions, etc. (e.g., for administrative employment).

The only regionally based manufacturer of forest products is the Little Valley Forest Products sawmill in Hagensborg. Since 1993, the operation has focused on value-added processing. The company currently produces stock for the manufacture of tongue-and-groove cedar plank paneling, and manufactures cedar lattice panels. Their annual capacity is estimated at five million board feet and, in 1996, they employed up to 30 people on a seasonal basis. Little Valley Forest Products is undergoing an expansion of its operation in order to produce other specialty products, including sliced overlaying veneer.

4.1.5 Stumpage and other Government Revenues

The provincial government receives a significant amount of revenue from the timber harvesting in the Plan Area. The largest source is from stumpage; using the April 2000 Coast Target Stumpage Rate of $23.23/m3, if the entire 4.0 million/yr. potential short term annual volumes (AACs plus volumes from Timber Licenses) are harvested, over $90 million would be collected annually. Tables 20 and 21 below provide historical data on volumes billed and stumpage/royalties paid from the Plan Area. Note that while stumpage paid on Small Business Forest Enterprise Program (SBFEP) timber tends to be higher than that paid by licensees, the latter incur the higher costs due to road development and silviculture obligations.

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[13] The Ministry of Finance and Corporate Relations' BC Input-Output Model estimates that anywhere from 1 to 1.5 additional spin-off jobs (includes both Plan Area and outside employment) are associated with each direct forestry job. The eventual Socio-economic/Environmental Assessment of the Central Coast LCRMP Scenario(s) will include estimates of these "multiplier effects" for the Base Case and the Scenario impacts, once MoF-generated timber supply modeling has been undertaken.

Table 20 :Timber Volumes/Stumpage Billed in the Mid Coast Forest District

Year	Total Crown Volume Billed (m3/yr)	Avg. Stumpage (TFLs)	Avg. Stumpage (TSA Forest Licenses)	Avg. Stumpage (SBFEP)	Total Stumpage & Royalties Billed
1992	1,543,248	$8.78	$5.85	$17.03	$11,646,106
1993	1,924,147	$8.14	$6.36	$14.35	$12,612,774
1994	1,585,944	$17.19	$10.33	$19.27	$18,439,427
1995	1,738,466	$24.81	$19.29	$11.59	$30,858,016
1996	1,357,921	$21.91	$15.08	$18.76	$23,367,584
1997	1,335,093	$25.87	$17.71	$51.61	$25,594,934
1998	1,141,550	$16.29	$13.32	$35.86	$16,438,219

Source: Ministry of Forests, Valuation Branch.

Table 21: Timber Volumes/Stumpage Billed in the Campbell River & Port McNeill Forest Districts

Year	Total Crown Volume Billed (m3/yr)	Avg. Stumpage (TFLs)	Avg. Stumpage (TSA Forest Licenses)	Avg. Stumpage (SBFEP)	Total Stumpage & Royalties Billed
Campbell River Forest District (includes lands outside of Plan Area)					
1992	4,990,699	$10.08	$10.44	$20.71	$49,131,643
1993	5,006,869	$11.97	$13.84	$13.82	$55,548,550
1994	4,437,119	$23.90	$29.18	$33.12	$105,287,011
1995	4,630,972	$30.72	$29.44	$34.38	$132,820,292
1996	3,999,942	$23.04	$24.76	$23.42	$91,788,081
1997	3,657,750	$21.32	$23.93	$42.66	$83,465,291
1998	2,904,812	$17.76	$19.74	$37.34	$59,485,283
Port McNeill Forest District (includes lands outside of Plan Area)					
1992	4,614,686	$10.88	$9.63	$12.08	$42,524,290
1993	4,971,581	$14.76	$11.94	$21.07	$60,329,158
1994	4,940,040	$28.39	$20.10	$33.28	$109,419,596
1995	5,378,320	$36.37	$22.84	$28.51	$146,253,032
1996	4,634,574	$34.67	$22.07	$22.52	$127,316,339
1997	4,408,292	$34.22	$31.19	$41.66	$140,731,099
1998	3,937,326	$30.04	$27.43	$55.94	$113,188,838

Source: Ministry of Forests, Valuation Branch.

Using MoF's 2000 Coastal target stumpage rate[14] and its estimates of industry/personal income taxes, overall provincial government revenues from the Plan Area's forest sector[15] are approximated in Table 22.

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[14] Recent actual stumpage rates are not used since they constantly changing for all MoF management units in order to arrive at the government's overall target rate for the Coast - thus the target rate is assumed to be the more accurate rate to use for future projections.

[15] While Base Case government revenues could in theory also be estimated for other sectors, data is less available than for forestry and thus would involve less defensible assumptions. In addition, in the eventual impact assessment of the proposed Scenario(s), because the *cause-effect relationship* between a "strategic-level" land use Scenario and

Table 22: Estimated Plan Area Current Provincial Government Timber Revenues*

	Avg. Annual Revenue/m3	Avg. Annual Revenue	Avg. Annual Revenue/m3	Avg. Annual Revenue
	North Plan Area		South Plan Area	
Stumpage (Coast Target Rate, Apr. 2000)	$23.23	$31,988,000	$23.23	$54,440,000
Industry Taxes (Corporate, Sales, etc.)	$9.05	$12,462,000	$8.66	$20,295,000
Personal Income Taxes (Direct Jobs)	$9.36	$12,889,000	$10.26	$24,044,000
Total Annual Government Revenues	**$41.64**	**$57,338,000**	**$42.15**	**$98,779,000**

Sources: MoF Valuation Branch and *Mid Coast* (1999) & *Strathcona TSA* (1999) *Timber Supply Reviews.*

* Estimates based on a 3.7 million m3/yr. AAC, exclusive of Timber Licenses; assumes 37% of harvest is in the North Plan Area (i.e., Mid Coast TSA, TFL 25, & North Coast TSA) and 63% is in the South Plan Area (i.e., Strathcona & Kingcome TSAs, and TFLs 39, 45, & 47).

Note that all of the above are gross revenue estimates, and do make any adjustments for the costs of administering the resource, government transfers to the forest industry or its workers, or environmental costs associated with timber harvesting.[16]

4.1.6 Recent Trends in Plan Area AAC's

Under the Ministry of Forests' Timber Supply Review process, new AACs are determined by the Chief Forester at least once every five years. For example, compared to the "pre-TSR 1" situation in early 1990's, 1996, the "post-TSR 1" TSA/TFL AAC in the Vancouver Forest region (which includes the Plan Area) had declined by 6.3% overall, with the conventional AAC (i.e., excluding partitioned harvests) being reduced by 9.3%. In the Central Coast, since the early 1990s, most conventional AACs also experienced significant reductions. For example, in 1992 the Mid Coast TSA experienced an AAC reduction from 1.5 to 1 million m3/yr., with no further reduction since. In 1996, the Kingcome and Strathcona TSAs experienced coniferous AAC reductions of 22.2% (399,000 m3/yr.) and 16.3% (274,000 m3/yr.) respectively; in January 2000, the Strathcona AAC was reduced by a further 10% (142,000 m3/yr.) As for the five TFLs noted in Table 17, their combined AACs (including lands outside of the Plan Area) increased by 4% (220,000 m3/yr.) from 1992 to 1996, partly mitigating the TSA impacts.

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timber harvest is much more direct/quantifiable than it is for sectors such as fishing, tourism, mining, etc., it is generally not realistic to estimate Scenario-driven revenue changes in revenues for these other sectors.

[16] For an analysis of these issues, see *Accounting for the Forests: A Methodological Critique of Price Waterhouse's Report 'The Forest Industry in BC,'* Ecological Economic Inc. for the Sierra Club, 1999.

4.1.7 Outlook

Since at least 1996, there have been significant stresses on the BC coastal forestry industry, resulting in mill closures and temporary/permanent lay-offs. There are a combination of causal factors at work, including cyclical prices for products due to volatile world markets, lower AACs, the Canada-US softwood lumber quota, higher harvesting costs due to the Forest Practices Code and the necessity to harvest in higher-cost (e.g., upper elevation) areas, [17] lack of industry diversification, and the stumpage increases of the early 1990s. Note that provincial stumpage rates have been reduced as of 1998, but are still much higher than in Alberta, Ontario, and Quebec.[18] Continuing AAC reductions are expected in the Plan Area, as well as throughout most of the remainder of the Vancouver Forest Region, due to four main reasons:

- the Timber Supply Reviews (TSRs) generally indicate that current AACs are above long term (non-declining) harvest levels, due to the harvesting of (higher volume per hectare) mature/old growth timber at a faster rate than MoF estimates that (lower volume per hectare) second-growth stands can be re-generated over a series of rotations - this is more commonly known as the "fall-down effect;"
- the recently implemented Forest Practices Code (FPC), which constrains harvesting to some extent (e.g., due riparian zones, wildlife tree patches, etc.) in order to better protect environmental values;
- implementation of the Vancouver Island Land Use Plan (VILUP) will affect the AACs in management units within the Pt. McNeill and Campbell River Forest Districts; and
- while not taken into account below, the likely movement of at least some coastal forest companies (e.g., Weyerhaeuser) to more "variable retention" and "conservation-based eco-system approach" forms of harvesting due to current pressure from environmental organizations and major buyers of BC forest products (e.g., Home Depot) - this will exacerbate the probable downward trend on future harvest levels on the BC Coast, especially in the Central Coast due to its relatively high proportion of undeveloped watersheds and international interest by the environmental movement in the area.

For the Plan Area, future harvest projections for various MoF management units are discussed below, all based on existing MoF Timber Supply Review information:

Mid Coast TSA - In June 1999, MoF released the *Mid Coast TSA Timber Supply Review* ("TSR 2," which includes the FPC), which indicates, as the "base case" option, that the current AAC of 1,000,000 m3/yr. can be maintained for 80 years, with a step-down to a Long Term Harvest Level (LTHL) of 730,000 m3/yr after 100 years. (This harvest flow excludes the Smokehouse drainage and assumes a 10-year harvest deferral in all PAS Study Areas designated due to the CCLCRMP.) In March 2000, the Chief Forester determined that the AAC should be essentially unchanged at 998,000 m3/yr, including 200,000 m3/yr. specified for hemlock/balsam stands.

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[17] See *Financial State of the Forest Industry & Delivered Wood Cost Drivers*, KPMG et al., April 1997. This independent analysis concludes that the Coastal BC cost of one cubic metre of wood was $67 in 1992 and $113.35 in 1996. The $46.35 increase is broken down as follows: stumpage/royalty increase of $15.70, "FPC related" cost increase of $19.68, and "non-FPC related" cost increase of $10.97. Average 1996 coastal stumpage cost estimated at $25.84 in 1996 vs. $10.14 in 1992. Note also that FPC regulations have environmental benefits which may assist industry certification efforts and sales in world markets.

[18] According to recent IWA research, as of January 2000 the BC Coastal stumpage rate per m3 was $25.27 and the Interior rate was $26.95, vs. $10.98 in Alberta, $7.25 in Ontario, and $12.44 in Quebec. (Source: *Special Report - Madison's Canadian Lumber Reporter*. D. Smyth: June 2, 2000.)

Strathcona TSA - In February 1999, MoF released the *Strathcona TSA Timber Supply Review* ("TSR 2," which includes the FPC), which concludes that the current AAC of 1,420,000 m3/yr. cannot be maintained, with the base case indicating an immediate decline to 1,280,000 m3/yr. for the next 10 years, followed by further declines such that in 20 years, a steady "Mid Term Harvest Level" (MTHL) of 970,000 m3/yr. would be reached and would remain until the 10th decade. Since this TSA contributes only 197,500 m3/yr. or 6% to the overall Plan Area's overall AAC, future harvest trends for this management unit will not have a significant impact on the Central Coast economy, although the implications on Vancouver Island will be more noticeable. Consistent with the base case harvest projection of TSR 2, the Jan. 1, 2000 AAC has been reduced by 10% to 1,278,000 m3/yr.

Kingcome TSA - In July 1995, MoF released the *Kingcome TSA Timber Supply Review* ("TSR 1"); "TSR 2" has not yet been completed and a harvest flow projection was not available from MoF at the time of writing. The base case harvest flow in the 1995 TSR, which did not fully account for the FPC, indicated that an immediate reduction from the AAC of 1,658,770 m3/yr. (not including some additional partition harvests) to a short-term level of 1,068,600 m3/yr. may be necessary. Subsequently, the Chief Forester announced a new AAC of 1,244,000 m3/yr. of conventional harvest, plus a 130,000 m3/yr. partition AAC for low-productivity coniferous stands and 25,000 m3/yr. for deciduous harvesting; this resulted in an AAC decline of 22% in 1996. Furthermore, the 1995 base case projection indicated a reduction to an MTHL of 779,000 m3/yr. that would last from year #30 to year #150. There is no reason to suspect that that the "TSR 2" would be significantly more optimistic, given that it will incorporate additional FPC constraints. The harvest flows for Kingcome have more relevance for the Central Coast, given that the vast majority of the Kingcome THLB is situated on the mainland rather than on Vancouver Island. MoF's target date for release of the Kingcome "TSR 2" timber supply analysis is Winter 2000/01.

North Coast TSA - In November 1999, MoF released the *North Coast TSA Timber Supply Review* ("TSR 2"), in which the base case harvest projection indicated that the current AAC of 600,000m3/yr can be maintained for the next twenty years, and then over the subsequent 50 years the harvest level is projected to decline by about 10% per decade to the long-term harvest level of 361,000 cubic metres per year. The ~149,000 ha. of the North Coast TSA within the Central Coast Plan Area comprises about 8% of the TSA itself and 3% of the Central Coast Plan Area. In addition, about 5,629 ha. (5%) of the overall 114,297 ha. North Coast THLB is within the Central Coast Plan Area. Therefore, harvesting activities the North Coast TSA (primarily by Interfor and West Fraser) are not considered to have a significant influence on the Plan Area's forestry sector. Note also that about 126,000 m3/yr. is slated for short-term harvesting during the next several years in that part of the TSA within the Central Coast Plan Area, which is a far higher proportion of the North Coast AAC than the 5% of the TSA THLB in the Plan Area.

TFL #25, Blocks #2 & #5 (Doman): Block 2 (12,593 ha of THLB = 11% of TFL) is located on Loughborough Inlet on the mainland portion of the Campbell River Forest District. The 1996 AAC for this Block was unchanged from its 1993 level of 92,000 m3/yr. however the conventional AAC was reduced to 70,000 m3/yr with 22,000 m3/yr deemed appropriate for heli-logging. The base case harvest flow forecast submitted for "TSR 1" by the Licensee and accepted by the Chief Forester indicates that the LTHL of 65,000 m3/yr. would be reached in 40 years, after declining 10% per decade. Block #5 (47,112 ha. of THLB = 41% of TFL) includes Princess Royal, Yeo, Roderick, and Pooley Islands and on the mainland extends from Millbank Sound in the south to Douglas Channel and Gardner Canal in the north. For Block #5, from 1993 to 1996, the AAC was also constant at 255,000 m3/yr., although of that total, the portion deemed to be suitable for heli-logging increased from 55,000 m3/yr. to 70,000 m3/yr., while the conventional component declined from 200,000 m3/yr to 185,000 m3/yr., as part of the Chief Forester's 1996 AAC determination for TFL #25. The base case harvest flow forecast submitted by the licensee for "TSR 1" indicates that a LTHL of 212,000 m3/yr. would be reached in 30 years, after declining 6% per decade. The FPC is not fully accounted for in "TSR 1," and harvest flow information for "TSR 2" was not available from MoF at time of writing. MoF's target date for release of the TFL #25 "TSR 2" AAC Decision/Rationale is December 2001.

TFL #39, Blocks #3, #5, & #7 (Weyerhaeuser): These Blocks contribute about 405,000 m3/yr. in AAC to the Plan Area. Block #3 (12,421 ha. of THLB = 3% of TFL) is the "Coast Islands" portion and consists of various islands/peninsulas between northern Vancouver Island and the Central Coast. Block #5 (10,370 ha. of THLB or 2% of TFL) is the "Phillips River" component, in the Phillips River drainage in the vicinity of Loughborough Inlet. Block #7 (17,757 ha. of THLB = 4% of TFL) is the "Namu Block," and is wholly located within the Mid Coast Forest District along Fitzhugh Sound. The analysis submitted by the licensee and accepted by the Chief Forester for "TSR 1" for the entire TFL projected that an initial harvest level of 3,733,000 m3/yr. would be reduced by 3.4% per decade until reaching an LTHL of 3,236,000 m3/yr. after 110 years; the 1996 AAC was reduced by only 2.2%, from 3,818,000 m3/yr. to 3,740,000 m3/yr. in 1996. The analysis also indicated that the initial rates of harvest were up to 24% higher than the LTHL for Blocks #3 and #5 combined and 47% greater for Block #7. (MoF indicates that the harvest rate for Block #7 is currently 173,000 m3/yr.) Using a weighted average approach based on the share of the THLB accounted for by each Block, it is estimated that the Central Coast portion of the harvest in this TFL will decline from about 405,000 m3/yr. presently, to something in the order of 307,000 m3/yr. when the LTHL is reached in several decades. Again, note that "TSR 1" did not fully incorporate the FPC and MoF's target date for release of the TFL #39 "TSR 2" AAC Decision/Rationale is December 2000.

TFL #45 (Interfor): This TFL is located in the Knight Inlet/Phillips Arm area of the Central Coast; it covers a gross area of 243,000 ha., contains 29,913 ha. of THLB, and contributes an estimated 220,000 m3/yr. (of which 10,000 m3/yr. is for the Small Business program) to the overall AAC of the Plan Area. This 1996 AAC was increased from the previous level of 210,000 m3/yr. The base case harvest flow forecast submitted by the licensee and accepted by the Chief Forester for "TSR 1" indicates that an MTHL of 167,000 m3/yr. would be reached in 30 years (after declining 10% in each of the first two decades and 6% in the third decade) before rising to 185,100 m3/yr. in 130 years. The FPC is not fully accounted for in "TSR 1," and harvest flow information for "TSR 2" was not available from MoF at time of writing. MoF's target date for release of the TFL #45 "TSR 2" AAC Decision/Rationale is October 2001.

TFL #47, Johnstone Strait Block (Timberwest): This TFL consists of five supply blocks, of which only the Johnstone Strait Block is within the Plan Area; it is located on various islands and peninsulas across the Strait from the Campbell River/Sayward. This Block contains an estimated 82,002 ha. of THLB (or 48% of total TFL's THLB) and currently contributes 425,000 m3/yr. to the Plan Area's overall AAC. The last AAC determination for this TFL resulted in an overall increase from 711,000 m3/yr. to 865,000 m3/yr., and was largely predicated on the licensee's base case timber analysis which indicated that the LTHL of 1,233,310 could be reached in 20 years. The analysis also indicated that for the Johnstone Strait Block alone, the current harvest level is approximately 37% below the LTHL estimate for this unit, which could also be reached in 20 years. Again, the FPC is not fully accounted for in "TSR 1," and harvest flow information for "TSR 2" was not available from MoF at time of writing. MoF's target date for release of the TFL #47 "TSR 2" AAC Decision/Rationale is December 2000.

TFL #43, Kingcome Block (Scott Paper): This area is a very small contributor to the overall Plan Area harvest, and is managed for deciduous (cottonwood) production. The overall TFL covers a gross area of 10,130 ha., with a THLB of 3,895 ha. and an AAC of 44,460 m3/yr.; the Kingcome Block, located at the head of Kingcome Inlet on the mainland portion of the Pt. McNeill, is only 962 ha. with a THLB of 520 ha. The TFL's estimated LTHL is 30,500 m3/yr. and the current contribution to the Plan Area harvest is under 9,000 m3/yr., enough to supply about 10% of the Scott Paper facility in New Westminster.

The overall AAC in the Central Coast will therefore continue to decline for a number of decades, as it will throughout most of the TSAs and TFLs in the Vancouver Forest Region. Notwithstanding that up-to-date timber harvest flow projections for all management units were not available for this report, order-of-magnitude estimates of the anticipated short term and long term declines are provided in Table 23.[19] *Again, it is emphasized that these estimates do not take into account further likely declines due to future movements towards more variable retention/ecosystem-based logging by coastal Licensees.*

Table 23: Estimated Short/Long Term Harvest Implications under Base Case Management

MoF Management Unit within Central Coast Plan Area	Current AAC in Plan Area*	Estimated Post-FPC AAC in 10-20 Years	Estimated 10-20 Year Harvest Impact	Estimated Post-FPC Medium/Long Term Harvest Level in 20+ Yrs
	Cubic Metres per year			
North Coast TSA	30,000	30,000	0	18,000 in 50 yrs
Mid-Coast TSA	1,000,000	1,000,000	0	730,000 in 80 yrs
Strathcona TSA (Plan Area)	197,500	152,075	45,425	134,911 in 20 yrs
Kingcome TSA (Plan Area)	1,096,000	765,930**	330,070	589,960 in 30 yrs**
TFL #25, Blocks #2 & #5	347,000	293,102**	53,898	229,620 in 30 yrs**
TFL #39, Blocks #3, #5, & #7	405,000	333,025**	71,975	264,020 in 30-85 yrs**
TFL #45	220,000	179,784**	40,216	143,620 in 30 yrs**
TFL #47	425,000	454,000**	(29,000)	500,520 in 20 yrs**
Total	**3,720,500**	**3,207,916**	**512,584**	**2,610,651**

Sources: MoF *Timber Supply Reviews* (TSAs) and *Rationale for AAC Determinations* (TFLs).
* Excludes ~300,000 m3/yr from Timber Licenses and the ~100,000 m3/yr. higher short-term harvest in the North Coast TSA portion of the Plan Area which, over time, would be spread more evenly over the TSA.
**Only "TSR 1" analyses were available for these units, and thus the harvest levels were adjusted downward by 9.2% in the short-term and 14% in the long term, as per the estimates for the Vancouver Forest Region contained in *Forest Practices Code Timber Supply Analysis*, MoF, February 1996. Note that the harvest flows in Table 23 are rough estimates generated by the author and should not be attributed to MoF.

The estimated short-term (i.e., the next 20 years) impact of 513,000 m3/yr is enough to support one relatively large sawmill plus approximately 200 Person-Years (PYs) of direct woodlands employment in the Vancouver Forest Region, of which about 20 PYs (under 2% of Plan Area employment) would be

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[19] Estimated from *TSR* & *AAC Rationales* as follows: **(1) Mid Coast TSA:** "*TSR 2*" Base Case (revised operability) harvest flow projected as stable at 1,000,000 m3/yr for 80 years with an LTHL of 730,000 m3/yr in 100 years; **(2) Strathcona TSA**: "*TSR 2*" Base Case indicates a 23% decline in harvest vs. current AAC after 10 years and a 31% decline in harvest after 20 years to a steady Mid Term Harvest Level (MTHL) for another 80 years; **(3) Kingcome TSA:** "*TSR 1*" Base Case indicates a 23% harvest reduction after 10 years and a 37% decline to a steady MTHL for a further 120 years; **(4) TFL #25, Blocks #2 & #5:** *AAC Rationale* using "*TSR 1*" Base Case harvest flow indicates a 10% decline vs. current AAC after 10 years with a 29% decline to a steady LTHL after 40 years for Block #2 and for Block #5, a 6% decline vs. current AAC after 10 years and a 17% decline to a steady LTHL after 30 years; **(5) TFL #39, Blocks #3, #5, & #7:** For Block #3, a 3.4% reduction after 10 years to the LTHL of after 85 years is indicated and for Block #5 & #7, respectively a 7% and 15% 1^{st}-decade decline is anticipated, with LTHL being reached in 30 years. Note that no adjustments are made for planned variable retention harvesting policy by Weyerhaeuser/Weyerhaeuser. **(6) TFL #45:** *AAC Rationale* using "*TSR 1*" Base Case harvest flow indicates a 10% harvest reduction vs. current AAC after 10 years and a 24% decline to a steady LTHL after 30 years; and **(7) TFL #47:** *AAC Rationale* using "*TSR 1*" Base Case harvest flow indicates that current AAC can be increased by 37% to a steady LTHL in 20 years, thus increase of 18% is assumed after 10 years.

Central Coast residents.[20] It appears that jobs dependent on the Mid Coast TSA and TFL #47 harvests are at less risk than those dependent on other management units. Additional harvest and associated socio-economic impacts of about the same order of magnitude are also likely to occur into the longer term (i.e., 20-40 years), but are more uncertain. Also, the northern Vancouver Island economy is more vulnerable (vs. the Lower Mainland, for example) due to its relative lack of economic diversification, problems in the fishing industry, and the fact that it is coping with its own significant AAC reductions on the Vancouver Island portions of the Campbell River and Pt. McNeill Forest Districts.

Other noteworthy economic trends include the 1998 announcement by MacMillan Bloedel (now Weyerhaeuser) that it will "phase out conventional clear-cutting" (and instead practice a "variable retention" harvesting system) over the next five years.[21] As noted previously, other coastal BC forest companies are also looking at similar approaches but currently it is unclear what the timber harvest and/or cost implications of such a move would be. It is possible that companies may attempt to mitigate impacts by pursuing such strategies as emphasizing retention of old growth forests in less developed areas by, as much as possible, moving operations to second growth and fragmented old growth areas; note that such an approach is more feasible in the southern portion of the Plan Area, where there are higher proportions of second growth stands than in the north. Negotiations between some of the Licensees and environmental organizations on these sorts of issues are ongoing, and the eventual analysis and possible longer-term forest management recommendations that are generated as part of that process is expected to be presented to the LCRMP Table, First Nations, etc. for their consideration in the near future. During the negotiations, the parties have agreed that some key areas on the BC Coast will be deferred from harvesting and concurrently, environmental groups will refrain from focusing on the participating companies in international campaigns highlighting BC forest practices.[22]

A related development is that some Licensees operating in the Plan Area and elsewhere on the BC Coast are seeking environmental certification for their forest products (based upon licensee logging practices) by third-party organizations such as the Canadian Standards Association, the International Standards Association, and the Forest Stewardship Council. If successful, it is likely that certification will aid in the marketing of BC forest products abroad, given increasing environmental concerns in other countries with respect to BC forestry practices.

4.1.8 Planning Zones

"Landscape Units" (LUs) and "Coastal Planning Units" (CPUs) have been established by government both for the LCRMP and for eventual lower level planning purposes. Regarding the former, it is understood that the LCRMP will be using LUs and combinations of LUs for terrestrial planning, much of which will involve management direction for forest practices, although other values (e.g., mining, tourism, environmental, etc.) will also be addressed. Map 6 shows the location of the LUs and CPUs for both the north and south portions of the Plan Area.

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[20] Woodlands PY job impact estimated as (1,558 workers/4,026 AAC) x 512,000 m3/yr = 198 PYs annually. The nature/significance of the socio-economic impacts are largely dependent upon the length of the time period over which the impacts are phased in and the adjustments that companies are able to make to mitigate the impacts (i.e., finding fibre from other sources, increasing value-added, use of FRBC funds, re-locating workers, use of early retirement/attrition, use of periodic down-time rather than permanent lay-offs, etc.)

[21] *MB Journal*: Bulletin #5, June 1998, pp. 4-5. Note that Weyerhaeuser, which has gained control of MacMillan Bloedel, has indicated that it will retain the variable retention policy.

[22] *Forest Companies and Environmental Groups Pursue Unprecedented Solutions Initiative*: News Release, July 28, 2000.

4.2 Commercial Fisheries[23]

4.2.1 Background

First Nations residing in the Plan Area have historically utilized most of the available marine resources, including octopus, crabs, squid, clams, mussels, eulachons, scallops, barnacles, sea urchins, cockles and abalone and continue to harvest these resources for important food, social, economic, and ceremonial purposes. These marine resources are culturally important and have a high significance due to the distance of the local communities from major transportation routes and the resulting expense of imported food products. In addition, members of these First Nations are major local participants in the commercial fishing industry within the Plan Area. As of 1996, fishing-related activities provided about 8% of the personal incomes of Plan Area residents (see Table 9 in Section 3.2).

Workers in the commercial fishery harvest, process, and market raw fish and shellfish into intermediate or finished food products for consumers. The industry in BC involves several linkages or activities between the natural resource in its marine environment to the final products available to the consumer. These activities are:

- **Harvesting** — Commercial fishermen harvest over 80 different species including salmon, herring, groundfish, and shellfish using, depending on the target, a variety of nets (seine, gillnet, trawl), hooks and lines (troll, longline), traps, diving techniques or other gear.
- **Processing** — Raw fish and shellfish reach commercial processors via packing by sea to processing plants, custom unloading at transhipment points, and trucking. Commercial processors then transform raw fish and shellfish into a variety of live, fresh whole, frozen whole, fillet, steak, smoked, canned, roe, and other products.
- **Distribution** — The majority of final processed products reach consumers through wholesale and retail food channels. Some of the distribution and sale of shellfish such as prawns and crab is done directly by the fisher.

Earlier in last century, as elsewhere along the coast, there were a large number of fish packing and processing plants scattered along the coast and largely supplied by local fishers. However, with better refrigeration and improved transportation methods, processing tended to centralize outside of the Plan Area in distant major population centres to take advantage of the economies of scale associated with larger facilities. At the same time, larger, more technologically advanced fishing vessels increased the mobility of the fishing fleet. Virtually all of the catch within the Plan Area is now processed elsewhere. As of 1996, only three relatively small processing plants were located within the Plan Area: Bella Bella-Waglisla (the largest, and licensed for salmon, herring, groundfish, and shellfish), Kitasoo Seafoods in Klemtu (licensed for invertebrates such as sea cucumbers and urchins), and the smaller Bella Coola Valley Seafoods (licensed for salmon only) in Bella Coola; there is also a smoker plant owned by the Nuxalk in Bella Coola that operates intermittently. Additional processing facilities are located just outside the Plan Area in Pt. Hardy, Sointula, and Quadra Island.

Most of the salmon processed in the Plan Area is headed, gutted and then frozen as the transportation distances to major population centers largely precludes accessing markets for fresh fish; the processed product moves on reefer trucks by ferry to Port Hardy and then to Vancouver. The major markets for locally processed salmon are southern Canada, the U.S.,and offshore, while all of the spawn-on-kelp processed is destined for the Japanese market. The major processing plant in the Plan Area is at Bella Bella, which operates for two months in the spring to process spawn-on-kelp and for two summer months to process salmon. - up to 50 people may be working in the plant at the peak times.

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[23] This section (and the Aquaculture section) includes significant commercial fisheries information for the Central Coast Plan Area from an unpublished report by *G.S. Gislason et. al.*: 1999, prepared for DFO as input to the Base Case report and from other reports by G.S. Gislason & Associates.

In addition to habitat protection and enhancement, the key economic issue in managing most fisheries is the "common property resource" problem. Essentially, this means that it is difficult to assign allocation rights for the resource to specific users (unlike timber or minerals, fisheries are mobile). This creates an incentive at the individual level to take as much as possible with little incentive to conserve, since one cannot be assured that he will reap the longer term benefits of conservation. The predicted result in economic theory is that utilization/extraction of the resource has a high potential to exceed the sustainable level in the absence of some form of assigned property rights and/or stock management by a regulatory body. Therefore a major objective of the Department of Fisheries and Oceans (DFO) is to assign user rights (traditionally through licenses, gear regulations, seasonal openings/closings, etc. and more recently for some groundfish stocks, via individual quotas) that attempt to be consistent with sustainable fishery harvests.[24] This is a challenging task given the scarcity of the resource in relation to the demands of the various user groups.

Finally, commercial (as well as First Nations and recreational) fishers have benefited from salmon production under the *Salmonid Enhancement Program* (*SEP*) through several hatcheries that have operated in the Plan Area, many of which have significant First Nations involvement. A list of enhancement facilities can be found as Appendix B to the *Anadromous/Freshwater Fisheries* component (Part 4) of the Base Case.

4.2.2 Licenses and Key Fisheries Harvested

Participation of Plan Area residents in the commercial fishery is concentrated in the harvesting and processing of salmon (mostly chum and sockeye) and herring spawn-on-kelp; the shellfish harvest is also gaining importance, but employment levels are not known. Some resident fishers within the Plan Area harvest other areas of the coast while many from elsewhere harvest within the Plan Area. In 1997, Plan Area residents held 113 commercial salmon "A" and "N" licenses and 10 herring spawn-on-kelp "J" licenses. Thirteen additional commercial salmon "F" licenses were held communally by resident First Nations in the Plan Area as shown in Table 25. These licenses generated an estimated 300 known seasonal jobs, with about two thirds of these in salmon and one third in herring spawn-on-kelp. The majority of license holders live in the northern portion of the Plan Area, specifically in Bella Bella. An estimated 50 additional seasonal jobs have been associated with local processing of salmon and herring spawn-on-kelp primarily at the Bella Bella Fisheries plant.

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[24] This is why some economists argue in favour of allocations of "fishery runs" for specific users so that such groups can capture the benefits of present-day conservation efforts, although such a policy may not be appropriate or practical in all circumstances. Two examples of this more "property rights" type of approach are (1) DFO policy of managing more groundfish stocks under "Individual Quotas" and (2) the inclusion in the Nisga'a Treaty of a specific allocation of a particular salmon run for the Nisga'a people.

Although there are many more commercial salmon licenses held by Plan Area residents, the recent data indicates that the spawn-on-kelp fishery is the larger economic generator. In 1997, it is estimated that the spawn-on-kelp fishery generated $4 million in revenue and $2 million wages, vs. approximately half these amounts for salmon – see Table 24. In addition, it is likely that the net income to the actual operators for spawn-on-kelp would be positive whereas net income from salmon would be negative.

Table 24: 1997 Revenues/Wages from Salmon and Spawn-on-Kelp Operations in the Central Coast

		# Licenses of Plan Area Residents[a]	**Average Gross Revenue per License[b]**	**% Crew Share for Wages[c]**	**Estimated Gross Revenues and Wages**	
					Revenues	**Wages**
Salmon	- seine	6	$55,000	50%	$330,000	$165,000
	- gillnet	104	$15,000	30%	$1,560,000	$470,000
	- troll	3	$30,000	35%	$90,000	$30,000
	Total	**113**			**$1,980,000**	**$665,000**
Spawn-on-Kelp		10	$400,000	50%	**$4,000,000**	**$2,000,000**

Source: *Gislason et al:* 1999.

[a] License counts refer to operations for which the license holder and/or skipper live in the Plan Area (see *Fishing for Money*: Gislason et. al., 1998 report for the BC Job Protection Commission).

[b] Assumed for the purposes of this analysis that all salmon licenses are northern licenses, i.e. Area A seine, Area C gillnet, and Area F troll (gross revenue or landed value information from DFO).

[c] Crew shares are estimates based on previous work by *G.S. Gislason & Associates Ltd.*: 1993 and interviews conducted for this study (the spawn-on-kelp % crew share is higher than for other regions of the coast because of special crew share arrangements for "open pond" operations).

Table 25: Commercial "F" (Communal) Licenses Held by Plan Area First Nations

		North Plan Area	**South Plan Area**	**Non-Resident**	**Total**
Salmon	- seine	12	0	20	32
	- gillnet	1	0	2	3
	- troll	0	0	0	0
	Total	**13**	**0**	**22**	**35**
Roe Herring		2	0	0	2
Rock fish		3	0	1	4
Red Sea Urchin		3	0	0	3

Source: *Gislason et al*: 1999.

* Based on information from DFO Licensing

Map 7 depicts DFO's "Statistical Areas" for BC, which are the geographic units used for its administrative purposes. The northern Plan Area encompasses part of Area 6 (north), as well as Areas 7 to 9; the southern portion of the Plan Area includes Areas 10, 11, 12 and a portion of Area 13. In addition to salmon and herring spawn-on-kelp, other important fisheries harvested for commercial and sustenance purposes in the Plan Area include clams (the Heiltsuk have a community-based license in DFO Statistical Area 7), crabs (at least one crab license in the Plan Area, located in DFO Area 7 with further potential in Areas 7, 8, 9, & 10) spot prawns (in DFO Areas 6-10), geoduck (1998 quota held by geoduck license holders for the Plan Area is 2.2 million pounds distributed among 31 licenses), red sea urchins (significant amounts caught in Areas 6, 7, & 8), sea cucumbers (currently under restrictive conservation management coastwide; licenses are held by the Kitasoo and the Heiltsuk), shrimp, scallops, octopus, and numerous types of groundfish.[25]

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[25] Renwick & Associates, *Feasibility Study for a Seafood Processing Plant in Bella Coola*: 1997, pp. 8-13.

4.2.3 Employment, Historical Trends, and Recent Initiatives[26]

In the Plan Area, according to the Census labour force information provided in Table 6 in Section 3.1, ***resident*** employment in the commercial harvesting of fish was quite stable (160 to 200) during the 1986-1996 period. As for fish processing, by 1991, this sub-sector provided approximately 250 more resident jobs (largely seasonal) in the Plan Area. Thus harvesting and processing combined to account for more than 20% (over 400 jobs) of the Plan Area's resident labour force in 1991. However, with the closure of the processing plants in Namu and Shearwater, by 1996 those employed in that component of the local industry numbered only about 85; this implies that by 1996, fishing and related processing accounted for only about 13% (~285 workers) of the Plan Area labour force. This coincides with a 1997 estimate of ~300 jobs (some of which are likely ***non-resident***) comprised of ~170 in the salmon fleet, ~100 in herring spawn-on-kelp, and ~30 in processing/distribution. (*Gislason et al*: 1999.) However, salmon fleet jobs were declining during this period, and have almost certainly continued to fall since that time.

A recent report for the BC Job Protection Commission (*Gislason et al*: 1998) identified the Central Coast as being within the top 15 impacted areas in the province, with employment effects accounting for a 5% loss in the total area workforce. The events that have impacted the local salmon fishery are part of larger trends that are affecting most BC salmon stocks, and should be viewed in that context. Due to a combination of over-capitalization of the fishing fleet causing excessive harvesting pressures on at least some stocks, habitat degradation due to human activities, and global environmental change, the catch levels in BC's wild salmon fishery have been declining in recent years.[27]

It is noted that the average annual BC catch of the five main salmon species has declined from over 88,000 tonnes in the 1986-90 period, to 69,000 tonnes during 1991-95 to 48,000 tonnes in 1997 as shown in Table 26;[28] data for 1998 indicates salmon landings fell further to 30,200 tonnes, the lowest level in 50 years.[29] Provincial catch levels for coho and chinook have been subject to the most serious decline, although these are not the most commercially significant species in the Plan Area. Prices for wild salmon have also been steadily falling since the mid-1980s due to world market conditions, i.e., the growth in world supplies of both wild and (especially) farmed salmon. Table 26 also indicates the impact that these factors have had in terms of revenues and "Real Gross Domestic Product" or "RGDP" (i.e., GDP adjusted for inflation, which is the most accurate indicator of the economic value of a sector) in BC - by 1997, RGDP generated by the province's commercial salmon fishery (excluding processing) had fallen to $66 million, or less than 0.1% of BC's total $86 billion of RGDP.[30] [Overall, RGDP for all species comprising the commercial fishery (excluding aquaculture, processing, and sport fishing) was $194 million in 1997 or 0.2% of the BC total, which is also less than what it was in the early 1990s due to revenue declines in salmon and other fisheries.]

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[26] Due to lack of data on other fisheries, this section concentrates on the salmon resource.

[27] See *Fish on the Line - The Future of Pacific Fisheries*: Carl Walters, UBC Fisheries Centre, 1995. While the relative importance of each of these factors as they affect Pacific fisheries is not known by fisheries biologists, Dr. Walters concluded in 1995 that we must "encourage development of safer and more selective fishing techniques" and that "there needs to be immediate restriction of some interception fisheries and management activities that are most threatening to long term biodiversity." (p. 61) Elsewhere in the same report, Walters states that "habitat protection specialists and biologists have often overstated the case for habitat damage as a cause of salmon decline" (p. 30) and adds that "climate change will impact not just abundances, but also our ability to monitor and respond adaptively to ecological change as it occurs." (p. 16)

[28] *Socio-Economic Impacts of Existing Salmon Farming Operations in British Columbia (Draft)*: Marvin Shaffer and Associates, 1997, p. 29.

[29] See *The 1998 BC Seafoood Industry Year in Review*: BC Ministry of Fisheries, 1999.

[30] See *BC's Fisheries & Aquaculture Sector*: BC STATS, February 2000. For comparison, in 1997 RGDP was $128 million for "Other Fin and Shellfish", $64 million for "Salmon Aquaculture," $205 million for "Fish Processing," $131 million for "Saltwater Sportfishing," $113 million for "Freshwater Sportfishing," $5.1 billion for "Forestry & Related Industries," and $4.1 billion for "Tourism."

Table 26: Economic Activity in the BC Commercial Wild Salmon Fishery - 1991 to 1997

	1991-94 Average	1996 Actual	1997 Estimate
Salmon Catch (tonnes)	75,700	34,600	48,400
Fleet Sales Revenues	$212 million	$103 million	$107 million
Processor Sales Revenues	$425 million	$210 million	$300 million
Real GDP, excluding processing ($1992)	$141 million	$46 million	$66 million
Fleet (seasonal), Processing, Supplier, & Handling Jobs	17,385	10,165	10,940
Fleet, Processing, Supplier, & Handling Personal Incomes	$170 million	$65 million	$81 million

Sources: *Fishing for Answers: Coastal Communities and the BC Salmon Fishery - Final Report*: ARA Consulting, 1996, Exhibit 6.1; *Fishing for Money - Challenges and Opportunities in the BC Salmon Fishery, Final Report*: G.S. Gislason & Associates, 1998, Exhibit 4.4; and *BC's Fisheries & Aquaculture Sector*: BC STATS, Feb. 2000.

It has been recognized for some time that particular salmon stocks on the BC coast have been threatened, as evidenced by federal initiatives such as the 1971 salmon vessel buy-back program and the later establishment of Dr. Peter Pearse's Commission on Pacific Fisheries Policy, which produced the report *Turning the Tide: A New Policy for Canada's Pacific Fisheries* (1982). In response to the problem of continuing excess capacity in the BC salmon fleet, in 1996 DFO undertook a significant voluntary license "buy-back" as part of the *Pacific Salmon Revitalization Plan* (i.e., the "Mifflin Plan") to both reduce the fleet and compensate license holders. In terms of the Plan Area, as indicated in Table 27, it is estimated that seasonal salmon fleet jobs were reduced by about 92 between 1995 and 1997 - it is evident that aboriginals in the Plan Area were the hardest hit by the reductions.

Table 27: Plan Area Commercial Seasonal Salmon Fleet Fishing Employment - 1995 vs. 1997 (excludes processing & other fisheries)

Community	Seasonal Salmon Fleet Jobs (all Plan Area residents)		Seasonal Salmon Fleet Jobs (First Nations Residents only)	
	1995	1997	1995	1997
Klemtu	11	6	11	6
Bella Bella	145	90	131	82
Bella Coola	101	73	58	45
Rivers Inlet	4	0	0	0
Total	**261**	**169**	**200**	**134**

Sources: *ARA Consulting*: 1996, Exhibit 7.2; *Gislason & Associates*: 1998, Exhibits 11.2 & 11.5.
Note: Estimates are not totally consistent with labour force estimates reported in Table 6 in Section 3.1, due to differing sources and years, and since the labour force reports "primary occupations" only, not secondary jobs.

Due to the license buy-backs of both the Mifflin Plan and DFO's 1998-99 *Pacific Fisheries Adjustment and Restructuring Program*, the number of commercial salmon licenses in BC has declined from about 4,400 to 2,200. It is likely that further job losses within the Plan Area and BC-wide have been associated with the post 1997 retirements. At the same time, while the number of licensed fishing vessels and their associated jobs have declined, there remains more than sufficient capacity in the fleet to harvest the available stocks. To ease transition, the *Pacific Fisheries Adjustment and Restructuring Program* has committed $400 million to help rebuild the resource, restructure the fishery and assist people and communities to adjust to the dramatic changes that are occurring.

As a result of the continuing decline in populations of some species of BC salmon, on June 19, 1998 the federal Minister of Fisheries and Oceans announced a *Coho Recovery Plan* and the *1998 Salmon Management Plan*, which outlines conservation as the key priority. On May 24, 2000 a DFO news release re-affirmed this principle and, in conjunction with other information on the DFO website, included the following details:

- allows salmon fishing opportunities for those sectors willing and able to implement highly selective fishing methods and again in 2000, selective fishing techniques are to be used when fishing for salmon and coho non-retention remains in place for most areas and fisheries;

- "special management zones" (covers most offshore BC waters where salmon stocks of concern are prevalent and specifies no coho retention; includes the area around Princess Royal Island and most of the southern portion of the Plan Area) and "yellow zones" (salmon fishing opportunities for all species and limited coho retention for First Nations and recreational fisheries, and applies to most of the northern portion and part of the southern portion of the Plan Area) will be used in 2000 to allow some flexibility in fishing opportunities, as abundance permits

4.2.4 Non-Salmon Commercial Fisheries

While it is prudent to place particular emphasis on the salmon fishery due to its traditional socio-economic importance to both the Plan Area and BC overall, economic activity associated with other fisheries should not be ignored. Most notably, in contrast to the salmon situation, many other BC wild fin and shellfish fisheries have seen increases in economic activity in recent years - excluding salmon, the average annual Real GDP (RGDP) generated by these other fisheries has increased from an annual average of $120 million during 1984-89 to $150 million during 1990-97, in spite of some recent declines beginning in the mid-1990s. (*BC STATS*: 2000) The Plan Area is taking part in this trend, as the participation of its residents (most being aboriginal) in such fisheries is increasing, although data is scarce. For example:

- As of 1998, Central Coast interests held 13 of BC's total of 46 spawn-on-kelp licenses - 10 in the North and 3 in the South. This activity is estimated to generate ~100 local jobs and more local income than the salmon fishery (*Gislason et al*: 1999). Also, as a result of the Supreme Court of Canada "Gladstone Decision", the Heiltsuk Band has acquired a significant number of additional licenses in recent years, from 2 in 1996 to 9 by 1998.

- There are considerable shellfish resources in the Plan Area and the landed value of all species of shellfish products in the Plan Area was approximately $35 million in 1996 (*Gislason et al*: 1999), but the majority of shellfish license holders live outside the Plan Area. Provincially, the landed value of shellfish increased from $46 million in 1990 to $120 million in 1997, according to DFO. Landed values can be cyclical due to such factors as Asian economic conditions.

A significant roe herring fishery also occurs each year in the Plan Area, in which openings for both the seine and gillnet roe herring fleets are normally held. Traditionally, the roe herring fishery has provided good incomes for license holders, although incomes also are characterized by some instability due to factors such as worldwide economic conditions, changing preferences in Japan, etc. The majority of roe herring license holders live outside the Plan Area.

As noted in the previous section, groundfish (BC landed value of $123 million in 1997, according to DFO), geoduck ($34 million), crab ($29 million), prawn ($26 million), red sea urchin ($14 million), sea cucumbers, shrimp, scallop, and octopus also make a local economic contribution.

4.2.5 Outlook

Along with the trend away from salmon to other species, other emerging trends in the BC fishery include:

- changing global seafood markets — the growth of aquaculture, specifically farmed salmon, and the dismantling of many international trade barriers have increased competition in the seafood industry
- weak Asian economies — weakness in the economies of Japan, Korea, Hong Kong and other Asian countries is dampening demand for seafood products
- biological uncertainty — changes in ocean conditions and freshwater environments may lead to lower productivity and survival
- an increased focus on conservation — conservation of weak stocks is the number one priority of DFO and the focus of its management efforts, even at the expense of foregone catch of stronger stocks
- stronger property rights — DFO, through individual quota management and other measures, is steering fisheries management towards systems of stronger property rights (not to be confused with privatization of the resource)
- access uncertainties — the lack of formal allocation, long term fishing plans, international agreements, and land claims resolution all contribute to uncertainty

The short term outlook for the salmon industry of the province as a whole and the Plan Area region is poor from both a harvest level and price perspective. Conservation concerns for weaker stocks (e.g., coho and chinook) and changes in the ocean environment likely will limit overall salmon catches to relatively low levels for the foreseeable future. A competitive seafood market and weakness in Asian economies likely will maintain downward pressure on prices in short term, but demand for seafood will continue to grow with world population growth.

Wild salmon may never re-establish its former significance in both the Plan Area and BC overall. According to the Job Protection Commission study (*Gislason*: 1998), the outlook until at least 2001 is for continued poor industry performance at the provincial level, due to mainly to climatic conditions affecting the catch and continued price competition from farmed salmon. This forecast is also supported by a DFO January 4, 2000 news release that stated the 2000 salmon fishing season is likely to similar to that of 1999, due to poor marine survival and "El Nino." Gislason[31] has concluded that 15 BC communities are especially vulnerable to the long-term decline in salmon stocks: Kyuoquot, Ahousat, Alert Bay, Sointula, Hartley Bay, Sayward, Kitkatla, Bella Bella, Bella Coola, Klemtu, Masset, Pt. Hardy, Ucluelet, Quadra Island, Tofino, Bamfield and Prince Rupert. Note that three of these are within the Plan Area and several others have socio-economic linkages to the Plan Area.

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[31] *Fishing Communities in Transition - The Gislason Review*: DFO website, 2000.

However, other observations provide some grounds for optimism for both Plan Area residents and the BC fishing industry overall:

- *Gislason* (1998) concludes that a reduction (from the 4000+ level of the early 1990s) to about 2500 licenses and 2000 vessels is needed to make commercial fishing viable for those remaining in the industry - as noted above, there currently are only about 2200 licenses remaining due to the several DFO-sponsored voluntary "buy-backs" that have occurred since 1996.
- There are opportunities in for economic growth associated with species/activities other than commercial salmon fishing, as noted earlier; indeed, already by 1997 the commercial salmon fishery (excluding processing) accounted for less than 10% of the overall $711 million of real GDP associated with commercial/sport/processing/aquaculture fishing industry in BC.
- Despite the problems facing the salmon industry, the more conservative management approach by DFO should help re-build stocks over time.
- Given the high proportion of the Plan Area population that is aboriginal, the Aboriginal Fisheries Strategy and treaty settlements should also increase local control of the resource.

A local group in the Central Coast, the Bella Coola Fisheries Steering Committee (includes representatives of the Nuxalk Band), recently commissioned a study[32] into the viability of a seafood plant for the community, for which processed fresh/frozen salmon (wild and farmed) would be the primary product, with potential diversification to occur later. The study concluded that there is a good chance that a viable processing plant could be feasible in Bella Coola, subject to a variety of assumptions which, according to the study, are quite conservative. However, a number of hurdles would have to be overcome before such a project were to proceed, including securing private sector financing, confirming a site, and more detailed study of a variety of issues. However, others knowledgeable about the industry are of the view that such a plant is not feasible at this time (*Gislason:* pers. comm.)

Finally, a note of caution from Dr. Carl Walters of UBC, who wrote in 1995 that "Our current fishery is not sustainable in either ecological or economic[33] terms, and it will very likely go the same way as Atlantic Canada within the next few decades if profound steps are not taken to restructure and protect it." (*Walters*: 1995, p. 4) Perhaps recent initiatives by DFO have gone some distance towards reducing such risks.

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[32] *Feasibility Study for a Seafood Processing Plant in Bella Coola*: Renwick & Associates and M Marketing Consulting, August 1997.

[33] A recent independent cost-benefit analysis concludes that between 1988 and 1994, the overall private and government costs of harvesting/managing the BC salmon fishery exceeded the benefits (i.e., landed values plus private economic rents) by an average of $56 to $112 million annually, but also indicates that the recent DFO license "buy-backs" may have since caused the benefits to exceed the costs. See Schwindt et. al., *Net Loss - A Cost-Benefit Analysis of the Canadian Pacific Salmon Fishery*: Journal of Policy Analysis and Management, Vol. 19, No. 1, 2000.

4.3 Aquaculture[34]

4.3.1 Background

The industry is comprised of two sectors: (i) farmed finfish (Atlantic, chinook, coho, trout and Arctic char) and (ii) farmed shellfish (Pacific oysters, Manila clams, and Japanese scallops); it cultures, processes, and markets finfish and shellfish into a variety of products . The key stages between the nurturing of the resource in its controlled marine environment and delivering the final product to the consumer are:

- **Farming** — the birth and initial rearing of finfish from broodstock eggs, and the birth and initial rearing of shellfish from spat or seed; the rearing and feeding of salmon in sea cages to market size; and the culturing of clams and oysters on foreshore "beds" or using off-bottom techniques
- **Processing** — including marine transport and harvesting into mainly gutted head-on whole finfish, live shellfish, and shucked oyster meat, and also some filleting
- **Distribution** — processed products are marketed through wholesale and retail channels

The most recent data indicates there are a total of 58 aquaculture operations in the Plan Area (see Maps 8a and 8b) which is somewhat less than the number of actual tenures. Of these operations, 54 produce salmon and four produce shellfish. The Plan Area is therefore home to the majority of the province's 85 active salmon farms, which are operated by, at last count, 16 companies. All of the region's aquaculture facilities except one are located in the southern portion of the Plan Area, although several applications have been filed for the Rivers Inlet area. By 1998, ownership of the 54 salmon farms was divided among 13 companies with the largest being Stolt Sea Farms (18 sites), followed by BC Packers (11 sites) and Omega (8 sites). In terms of future potential, Maps 8(c.) through 8(f) indicate BC Fisheries' best estimate of bio-physical capability for aquaculture siting within both the North and South portions of the Plan Area.

4.3.2 Employment and Income

Provincially, the salmon farming industry has been estimated to account for 1,142 Person-Years (PYs) of direct employment in 1996, 6.4% more than the 1993 level. (*Shaffer:* 1997, p. 21). Almost 60% of BC salmon farming employment is resident on northern Vancouver Island (e.g., Campbell River: 425 PYs; Comox/Courtenay: 115 PYs; Port Hardy: 84 PYs; Pt. McNeill: 28 PYs.) Total wholesale revenues generated by the BC salmon farming industry in 1996 are estimated at $162 million, of which $76 million or 47% is estimated to come from Plan Area operations. Based on this 47% share, Central Coast Plan Area operations are estimated to support an estimated 537 Person-Years (PYs) of employment (or an average of 10 per operation). In terms of actual jobs (as opposed to PYs of employment) another recent study has produced estimates that of a total of 1400 BC-wide jobs, 640 are associated with the Plan Area operations of which 30 are permanent Plan Area residents (*Gislason et al*: 1999, p. 9). Since the provincial "jobs" and "PY" estimates are comparable (1400 vs. 1142), it can be reasonably concluded that most salmon farming employment is year-round. Direct BC salmon farming pre-tax wages and benefits totaled $36.4 million (or about $32,000 per Person-Year, with labourers earning less and supervisors earning more) in 1996. Approximately 47% or $17.1 million of this amount is attributable to operations located in the Plan Area, but most of this income would be spent in mid and northern Vancouver Island communities where the vast majority of the workers reside.

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[34] Significant information in this section is taken from the *Summary Report of the Salmon Aquaculture Review*: BC Environmental Assessment Office, 1997; *Socio-Economic Impacts of Existing Salmon Farming Operations in British Columbia (Draft)*: Shaffer & Associates, February 1997; and *Gislason et al*: 1999.

Of the total BC salmon farming employment, an average of 40% occurs on the farms themselves with the remainder attributable to processing and work associated with hatcheries, transportation, sales, and administration. Note that there are no significant processing facilities for aquaculture products in the Central Coast Plan Area, with much of the product being sent to facilities in Campbell River and Port McNeill. As for shellfish farms, 1998 provincial wholesale values were about $12 million and as of 1995, employment on 93 BC farms surveyed by Statistics Canada was estimated to be about 600 part and full-time jobs;[35] with only five operations, the Plan Area portion of this is relatively minor.

4.3.3 Recent Trends

Salmon farming in BC only began in the 1970s, with the significant growth occurring from 1986 (when production was negligible) to 1991; according to Table 28, production reached 42,300 tonnes in 1998, surpassing the wild salmon catch of 30,200 tonnes for the first time. During this period, there has also been much rationalization in the industry due to lower salmon prices, cost issues, some environmentally inappropriate sites, and consolidations to improve efficiency. In 1996, the Plan Area's salmon farm operations produced an estimated 12,473 tonnes valued at approximately $76 million wholesale.

Table 28: Trends in Production and Revenues for the BC Aquaculture Industry

	Farmed Salmon	Oysters	Clams	Scallops	Shellfish Total	Overall Total
Production (tonnes)						
1987-90 Average	9,000	3,900	30	-	3,900	**12,900**
1991-94 Average	23,400	4,700	330	<10	5,000	**28,400**
1995	27,300	5,400	900	20	6,300	**33,600**
1996	27,800	5,500	1,000	140	6,640	**34,440**
1997	36,600	4,800	800	20	5,620	**42,220**
1998	42,300	5,300	700	20	6,020	**48,320**
Wholesale Value ($ mill.)						
1987-90 Average	52.7	4.2	0.13	-	4.3	**57.0**
1991-94 Average	137.4	5.8	2.1	<0.1	7.9	**145.3**
1995	172.8	7.7	4.9	0.3	12.9	**185.7**
1996	162.2	6.7	5.2	0.5	12.4	**174.6**
1997	191.5	6.3	5.1	0.4	11.8	**203.3**
1998	244.9	6.0	5.8	0.2	12.0	**256.9**

Source: *The Fishing Industry of British Columbia*: Gislason & Lam, 1997 and *The 1998 BC Seafood Industry Year in Review*, BC Ministry of Fisheries, 1999.

The European Union (EU), the US, and Japan are the major markets for farmed salmon. Japan is the world's largest salmon market (over 500,000 tons), accounting for one half of world demand. However, BC's main market is the US. Norway is the world's largest producer of farmed salmon, followed by Chile, Japan and then Canada. The Norwegian industry went through a major restructuring in the 1990s and succeeded in reducing costs through lower mortality rates, improved feed conversion rates, and genetic improvements.[36] If Canada is to stay competitive, similar changes may also have to occur in order to maintain and enhance future industry growth.

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[35] *Economic Potential of the BC Aquaculture Industry (Phase I)*: Coopers & Lybrand, 1998, p. 4.

A positive recent development for shellfish aquaculture occurred in November 1998, when the BC Fisheries and the BC Environment Ministers announced that the government would immediately begin accepting applications for expansion of existing shellfish farms and starting in March 1999 would process applications for new farms. The announcement included a move to streamline the tenuring and licensing process and to double the amount of Crown land under tenure to 4,230 ha. over 10 years. All applications are to be handled by a single, joint BC Fisheries/BC Assets and Lands Corporation (BCALC) office located in Nanaimo. Since the announcement, at least four new shellfish tenures have been granted.

Some First Nations have entered joint ventures for salmon farming while others remain opposed to this activity.[37] The Kitasoo and Homalco First Nations have operated salmon farms in the past, but these operations no longer exist. There is one salmon farm located within overlapping Kitasoo and Heiltsuk traditional territories that is joint ventured between the Kitasoo Nation and industry. Some First Nations are also providing contracted services to certain operations, and discussions are ongoing to broaden their participation in the industry in the Plan Area and elsewhere.

Much of the aquaculture industry of BC faces some of the same short-term challenges as the commercial fishing industry, namely, changing global seafood markets, weak Asian economies, and supply uncertainties. Regarding the latter, salmon aquaculture sector growth plateaued in the mid-1990s, after the provincial government declared a suspension in the issuance of salmon aquaculture tenures in 1995 due to concerns about potential environmental impacts. The BC Environmental Assessment Office (EAO) then conducted a review of the industry, with input from a wide variety of stakeholder groups. In 1997, the EAO published the *Salmon Aquaculture Review* (SAR), complete with 49 recommendations primarily aimed at reducing potential negative impacts. In October 1999, the BC government announced it would accept most of the SAR recommendations. This new Salmon Aquaculture Policy (SAP) announcement contains the following key provisions:

- a freeze[38] the number of existing tenures at 121 and provision for up to ten additional pilot sites (five fresh water and five marine) for research on closed-containment technology;
- a decision to relocate existing tenures that are not deemed suitable in their current location;
- development of "performance-based" environmental standards, rather than rules based on feed use;
- all salmon farms are required to implement approved escape prevention and recovery programs;
- a new regulatory framework through the development of an "Aquaculture Management Act;"
- establishment of an inter-agency fish health committee to develop and implement fish standards, code of practice, and reporting, as well as investment in "green" (e.g., "closed-containment") technologies;
- to work with DFO and the Office of the Aquaculture Commissioner to co-ordinate the management and development of the industry in the areas of provincial and federal responsibility.

4.3.4 Outlook

Global seafood demand is growing, fueled by population increases and rising incomes. Aquaculture products are increasingly being used to satisfy this demand because many (world) commercial fisheries are becoming over-subscribed. In fact, by 1997, world production of farmed salmon exceeded the world commercial salmon harvest for the first time.

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[36] *Canada's Aquaculture Industry - Discussion Document*: G.C. Vernon and Associates for DFO, 1999.

[37] In correspondence dated March 23, 2000 from the MTTC/KDC/Tlowitsis it is stated that "The majority of First Nations of the MTTC/KDC are against the farming of Atlantic Salmon in Pacific waters." It is also understood that the Heiltsuk are opposed to salmon aquaculture on its traditional lands.

[38] While the gross number of tenures is still 121, the tenure suspension is lifted in the sense that some existing tenured operations will be allowed to move to new, currently untenured sites.

There is potential in BC for both expanded production of established species such as salmon, trout, oysters, and clam sand for new species production such as scallops, geoducks, and mussels. Advances in growing technology have been made for both shellfish (abalone, spot prawns, sea cucumber, and sea urchins) and finfish (halibut, black cod, and lingcod). Species cultured in limited quantities in BC include Arctic char, sablefish, white sturgeon, geoduck, sea cucumber, and green sea urchin.

The federal Department of Western Economic Diversification recently released a study (*Coopers & Lybrand:* 1998) on the economic potential for shellfish and finfish aquaculture in BC, which concluded that the growth potential is high for both segments of the industry. For shellfish, while the presence of the industry in the Plan Area is currently low, given the availability of suitable sites (the study concludes that, using the west coast of Vancouver Island as an example, 1022 ha. (~25%) of the beach area is biophysically capable of supporting shellfish farms (of which only 44 ha. currently has shellfish aquaculture tenures), and thus accommodating this growth is feasible from a strictly logistical perspective. There is also an additional estimated 6545 ha. of capable deepwater areas. The Plan Area could presumably also benefit from this type of growth, although it would more likely be a longer term proposition due to the limited infrastructure and the distance from population centres. Note that the total area currently under shellfish farm tenure in BC is about 2200 ha., according to the Ministry of Fisheries.

As for finfish, the study reached similarly optimistic conclusions about market potential and biophysical characteristics of suitable sites, with the key constraint being identified as provincial policy with respect to new tenures. On the biophysical side, information contained in the SAR reinforces the point that the industry has considerable room to expand in BC and the Plan Area (subject to, obviously, site-specific environmental concerns, conflicts with other users, First Nations interests, etc.). For example, in the Broughton area, the SAR estimates that 11% of its coastline has the biophysical characteristics necessary for aquaculture and factoring in the SAR siting recommendations which would preclude many coastal areas, about 2-3% (3500 ha.) of the Broughton coastline would be available for sites (*Salmon Aquaculture Review*: 1997, Ch. 14) should the existing cap on tenures ever be increased. Therefore, significant future growth could still be accommodated in BC from a biophysical perspective since all existing 85 salmon farms in the province now occupy, according to the Ministry of Fisheries, only about 870 ha. It should also be noted that other species, such as black cod and halibut, could be economically viable for finfish aquaculture in the future

A future viable aquaculture industry in the northern part of the Plan Area has significant additional challenges, primarily because the transportation costs of feed and moving harvested species to the markets are significant. Subject to solving such issues, most of the local future potential for the industry is likely in the northern part of the Plan Area, since the southern portion (primarily the Broughton area) has been the focus of industry development thus far and is probably subject to the most conflicts with other users (e.g., recreationists, some First Nations, etc.)

The Marine Protected Areas Strategy (MPAS) is also a concern for the aquaculture industry. The objective of the MPAS is to protect representative marine ecosystems and areas with special recreational and cultural significance. Since the LCRMP is expected to make recommendations on coastal zoning, including Marine Protected Areas (MPAs), such areas may have constraining implications for future aquaculture siting. However, as noted above, the amount of under-utilized area suitable for expansion will be the primary determinant as to the extent to which both new PAs and MPAs, as well as other types of coastal zones, will affect the availability of future potential sites.

4.4 Tourism, Recreation, Hunting, and Trapping

4.4.1 Background

Visitors can access the Plan Area by Highway 20 from Williams Lake, by ferry from Port Hardy, by private/charter sea vessel, or by scheduled/charter air service from Vancouver. For the purposes of this analysis, recreation is defined to include various outdoor adventure activities pursued by both visitors and residents. Tourism, however, only refers to economic activity generated by non-residents of the immediate area (i.e., those traveling in excess of 80 kilometres) including those visiting for business purposes.[39] It is also assumed that "back-country/eco-tourism" activities (i.e., tourism activities involving more remote, less developed, nature-based experiences) is much more strongly linked to land and resource use than is "front-country" tourism (i.e., activities associated with hotels, restaurants, etc. in established communities). Furthermore, in the Plan Area most nature-based activities occur in marine and coastal areas, rather than in back-country terrestrial portions of the land base. Therefore, this section focuses largely on the nature-based/outdoor component of the industry, although many of the statistics reported are aggregated to portray all Plan Area tourism activity.

4.4.2 Tourism Overview, Employment, & Recent Trends[40]

According to the Ministry of Finance and Corporate Relations economic dependency analysis (see Table 9 in Section 3.2), tourism accounted about 16% of Plan Area resident employment (~320 jobs) and 10% of personal income in 1996. The local tourism industry is very dependent on the area's high quality outdoor recreation opportunities, in particular, sport fishing, marine touring, hiking, cross country skiing, wildlife viewing, kayaking, camping, and hunting.[41] It should be recognized that a large proportion of the recreational activities in the Plan Area tend to be marine-based, and therefore have a strong linkage to coastal resources.

The dependence of the tourism industry on outdoor experiences is reflected in Table 29, which summarizes the region's key tourism facilities and services. The Plan Area has an estimated 66 fixed roof accommodation facilities (50 lodges of various sizes, ten hotels/motels, and six "Bed & Breakfast" establishments), one BC Parks campground with 39 sites, five BC Forest Service camping areas with 18 sites, and three private campgrounds with a total of 110 sites. In addition, there are a number of guide-outfitter camps. Several of the B&Bs began operation only recently as a direct result of the new BC Ferry service. The Broughton Archipelago, including its marine park, is one of the region's most heavily used marine recreation areas, hosts between 60 and 80 marine tourism operators on a regular basis and another 20 to 40 on an occasional basis (these figures include lodges and fishing charters). The Hakai Recreation Area also attracts hundreds of tourists each year as it offers some of the finest fishing opportunities along the Central Coast. The Fiordland Recreation Area, though somewhat remote, offers one of the best examples of a coastal fiord along the entire BC coast.

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[39] Business travelers are included as per Ministry of Small Business, Tourism and Culture policy, which in turn follows an international convention. It is not clear what proportion of the tourism activity in the Central Coast is related to business travel, but it is understood that most visitors in the late Fall, Winter, and early Spring are traveling mainly for work-related purposes.

[40] While the employment estimates include jobs at fishing resorts and with guide-outfitters, these sectors are discussed separately because of their importance in the region.

[41] While there is no Plan Area analysis of eco-tourism growth available, at the provincial level potential in this sector is strong - see *Eco-tourism Nature/Adventure/Culture - Alberta & BC Market Demand Assessment*: HLA Consultants & ARA Consulting Group, 1995. This work also concludes that of those surveyed who were interested in undertaking an eco-tourism trip in BC, 51% indicated "scenery/nature" was their prime motivating factor.

Table 29: Central Coast Tourism Facility Inventory

Facility or Service	Number
Accommodation: - Fixed Roof (including Bed & Breakfasts) - Campgrounds	 66 4
Fishing/Marine Charters	42
Adventure Tours	31
Air/Helicopter Services	25
Guide Outfitter Territories (whole or portion)	10
Marinas	8
MoF Recreation Sites (& Trails) BC Parks / Recreation Area Sites BC Hydro Recreation Sites	13 6* 1

Sources: Ministry of Small Business, Tourism & Culture and Ministry of Environment, Lands and Parks.
* Only Tweedsmuir Park has developed campsites.

In addition, of the approximately 200 tourism facilities or services listed in the Ministry of Tourism's Central Coast tourism resource inventory, about 25% are owned/managed by Plan Area residents, with the remainder being owned/managed by non-residents.

Total 1996 visitor spending in the Plan Area has been estimated at $64 million, although only a minority of these expenditures would accrue directly to Plan Area residents as personal income. Of this total, the largest single proportion (54% or approximately $34 million) is attributable to the purchase of travel packages (i.e., fishing resorts, charters, etc.). Based on these visitor spending figures, total (resident and non-resident) tourism employment supported by the region is roughly estimated at 540 jobs (the majority of which have annual wages of under $20,000 and/or are seasonal) of which ~295 are attributable to companies that offer visitor packages (e.g., fishing lodges, charters), ~61 to the accommodation section, ~19 to the vehicle service sector, ~93 to other transportation companies, ~56 to the food services sector, and ~16 to other components of the retail and visitor service sectors. (See Appendix A for an explanation of the methodology used to derive these estimates.)

Using the Ministry of Finance and Corporate Relations estimate of 320 as the number of tourism jobs held by Plan Area residents, one is left with the conclusion that 40% of the overall number of tourism jobs generated in the Plan Area are held by non-Plan Area residents. Approximately 150 of the overall number of tourism jobs are in the sport-fishing sector alone, of which 115 are estimated to be held by Plan Area residents. (*Gislason:* 1998, Exhibit D.1; *Gislason:* 1999)

A relatively recent development important to the local tourism industry was the 1996 establishment of the BC Ferries Discovery Coast Passage Route from Port Hardy to Bella Coola (summer only), Bella Bella (McLoughlin Bay), Shearwater, Ocean Falls, Klemtu, and Namu. During the first year of operation in 1996, the service carried approximately 9,500 passengers, and has fluctuated between 8,600 and 9,000 up to 1999, with the count for the latter year at 8800.

In terms of an overall trend for tourism activity in the Plan Area, using the "Accommodation & Food Services" labour force data in Table 6 of Section 3.2 as a proxy for tourism employment, there has been a 26% overall growth in tourism-type jobs over the 1986 to 1996 period, representing an increase of some

35 jobs over 10 years. While relatively small compared to the 2000+ member labour force, this trend compares favorably to the other main resource sectors (i.e., forestry and commercial fishing, excluding aquaculture), neither of which grew consistently during this decade.

4.4.3 Visual Quality

Because of the assumed relatively strong linkage between many "nature-based" tourism/recreation activities and the land/coastal resource base, scenic quality is a key issue for tourists and residents.[42] This statement not only applies to those who actually visit the Plan Area, but also to individuals such as cruise line passengers, who also enjoy the scenery of the Inside Passage. Unfortunately the lack of docking facilities and other factors limit the ability of Central Coast residents to benefit from this lucrative market; however, from a provincial perspective, according to the Ministry of Small Business, Tourism and Culture (MSBTC), the Vancouver-to-Alaska cruise industry has grown markedly over the past two decades.

To represent scenic values that are of concern both currently and in the future, MSBTC has mapped areas in the Central Coast that it views are of the most visual importance from both its "overall tourism" vantage point as well as from the perspective of Plan Area communities and MoF also has its own "Scenic Areas" mapped - both are displayed as Maps 9 and 10 respectively. Table 30 contains the area statistics which overlay the Base Case management zones with this visual inventory mapping; note the statistics are only presented for the Timber Harvesting Land Base (THLB) portion of the Plan Area, since it is for these lands where the visual risks from industrial activity (i.e., timber harvesting) are most likely to occur.

It is apparent that in the northern portion of the Plan Area, 65% of MSBTC Priority #1 Areas and 34% of Community Priority Areas occur under a General Management regime, where the highest risks to visual quality from timber harvesting would occur in the Base Case. In the south, the respective figures are 66% and 76%. It is therefore the case that significant amounts of these visually sensitive areas would be compromised over time, which is of concern not only to some tourism businesses in the Plan Area, but also to resident/non-resident recreationists.[43] However, to the extent that forest licensees may practice more "variable retention" harvesting on their operating areas in the future (e.g., Weyerhaeuser), such a silvicultural regime is likely to be more compatible with visual quality.

Table 30: Distribution of Visually Sensitive Areas within the Timber Harvesting Land Base

	North Portion of Plan Area				**South Portion of Plan Area**		
Base Case Land Use Zone	MSBTC Priority #1 Areas	Community Priority Areas	MoF Scenic Areas		MSBTC Priority #1 Areas	Community Priority Areas	MoF Scenic Areas

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[42] See *Clearcutting and Visual Quality - A Public Perception Study*: Ministry of Forests, 1996. Using survey techniques, the study concludes that in general, the public rated alterations of a visual landform unit (e.g., a hillside) via clearcutting of more than 6% to be slightly, moderately, or very unacceptable. Note that the 6% often pertains to an area larger than simply the Timber Harvesting Land Base on the landform unit. While the study also concluded that individuals from communities like Campbell River and Prince George had a higher visual tolerance for clearcutting than did those from Kamloops and New Westminster, it also found that regardless of location, the level of public acceptance to the visual impacts of clearcutting was higher the less visual disturbance there was.

[43] Concluding that timber harvesting can have adverse visual impacts is not meant to imply that such activity is not desirable from a socio-economic perspective, just that there is a trade-off between the economic benefits of timber production vs. impacts on visual quality. This trade-off is obviously more significant in areas that are more visible to the public, i.e., in the mapped MSBTC and MoF visually sensitive areas described in this section.

General Management*	65%	34%	43%		66%	76%	28%
Preservation/Retention VQOs	10%	8%	14%		3%	0%	8%
Partial Retention VQOs	25%	50%	43%		30%	24%	64%
Deferrals re 1^{st} Nations Issues	0.3%	7%	1%		0	0	0
Existing Recreation Areas	-	-	-		-	-	-
Existing Protected Areas	-	-	-		-	-	-
Total (ha.)	**91,002**	**10,059**	**70,861**		**193,663**	**2,472**	**101,717**

Source: *LCRMP GIS Database:* BC Environment, Nanaimo.

* General Management refers to that portion of the land base managed under minimum FPC requirements.

The third inventory that is included is that for MoF-designated "Scenic Areas." While these areas are not as extensive as the MSBTC Priority #1 Areas (especially in the south portion of the Plan Area), the proportion of them that are managed under VQOs is higher in both the northern and southern portions of the Plan Area. However, not insignificant amounts are also contained with General Management zonation in the Base Case: 43% in the North and 28% in the South.

While not included in Table 30, of the 54 "Existing Tourism Facilities" that MSBTC has mapped for the northern portion of the Plan Area, under Base Case current management 13% are situated in Preservation/Retention VQO zones, 48% are in Partial Retention VQOs, and 8% are in Parks/Recreation Areas. In the southern portion, 16% are situated in Preservation/Retention VQOs, 39% are in Partial Retention VQOs, and 3% are in Parks. This data suggests that active visual management is occurring for about two-thirds of these operations in the North and in just over half in the South, with the remainder at higher risk of visual impacts, depending on the nature of the operation and its location with respect to the THLB. Notwithstanding, with the exception of the low proportion of both the north and south facilities in Parks/Recreation Areas, the remaining businesses are still at some risk of declining visual quality due to timber harvesting depending on the effectiveness of VQO management. In addition, in the absence of changes to current management, the viewscapes of many potential future tourism operations will continue to be compromised over the long term, especially those that could occur outside of current VQO zones.

4.4.4 Nature-Based and Back-Country Recreation

The Central Coast Plan Area provides a range of high quality outdoor recreation opportunities, most of which were noted above. Map 11 prioritizes the "Tourism Resource Values" in the Plan Area as judged by MSBTC. It is apparent that the most significant areas in terms of use are the coastal and many other lower elevation areas around rivers and lakes. From a coastal recreation perspective, a key activity is that of marine touring (refers to the use of a power, sail, or self-propelled vessel such as a kayak for pleasure purposes) which often involves a number of related activities including wildlife/scenic viewing, photo touring, etc. which are somewhat dependent on relatively pristine environmental values. At present there are eight marinas and an unknown number of charter operators that service the marine touring industry. The Plan Area offers high quality marine touring resources, with the primary use areas being the Seaforth Channel-Hakai Recreation Area, Rivers Inlet, Broughton Archipelago-Knight Inlet, and Sonora Island. Although marine touring activity appears to be increasing, accurate use figures are unavailable.

On the terrestrial side, according to BC Parks, a total of 11,594 day-use visitor parties and 2,013 overnight visitor parties made use of Tweedsmuir Park in 1996. Of overnight visitor parties, 585 (29% or approximately 1,755 persons) used the Park's back-country resources. There are only limited hiking trails in the Plan Area due its remote nature and generally rugged terrain. The key trails include the south Tweedsmuir Park trails (e.g., the Alexander Mackenzie Heritage Trail), ten Ministry of Forest trails, and some others. A total of 223 parties signed in at trailheads in 1996, with an average of 3-5 persons per party, but it is likely that these figures only represent only a small proportion of the actual trail users.

For many back-country recreationists, relatively pristine "wilderness" is an important consideration. While difficult to define and measure, MoF does have an inventory of "Undeveloped Watersheds" (UWs) that is one proxy for wilderness, as shown in Map 12. (Note that Map 13 shows only the Undeveloped Watersheds > 5000 ha., given that the size of UWs is also of concern to those interested in wilderness values.) About 1,589,000 ha (54%) of the Gross Land Base (GLB) in the northern portion of the Plan Area and 467,000 ha. (28%) of the southern portion were classified as UWs when the inventory was done in the early 1990s. However, it is the portion of these lands at lower elevations (i.e., those in the CWH biogeoclimatic zones) that have the highest probability of timber extraction, and are therefore of most concern to recreationists. Thus, the area statistics reported in Table 31 pertain to the "Low Elevation" portions of these watersheds, both by Gross Land Base (GLB) of the Plan Area as well as the THLB. The key conclusions are that:

- In the North, 13% of Low elevation UWs are in Recreation Areas or Parks, but none are located in these designations in the South; and
- In the North and South, only 9% of Low Elevation UWs are contained in the THLB but these lands are at a very high risk of roaded development.

Table 31: Low-Elevation* Undeveloped Watersheds by Zone Category

	North Portion of Plan Area		South Portion of Plan Area	
Base Case Land Zone	**GLB**	**THLB**	**GLB**	**THLB**
General Management	69%	78%	94%	94%
Preservation/Retention VQOs	4%	4%	2%	2%
Partial Retention VQOs	13%	15%	4%	5%
Deferrals re 1st Nations Issues	2%	2%	0%	0%
Existing Recreation Areas	12%	-	0%	-
Existing Protected Areas	1%	-	0%	-
Total (ha.)	**866,760**	**80,062**	**136,686**	**12,574**

Source: *LCRMP GIS Database:* BC Environment, Nanaimo.

* "Low Elevation" areas defined as Coastal Western Hemlock (CWH) biogeoclimatic subzone variants.

However, it is sometimes argued that a relatively minor amount of roads in a watershed (or in a portion of one) should not detract from a "wilderness experience" within much (if not all) of that watershed. Therefore, a broader indicator of back-country opportunities is MoF's "Recreation Opportunities Spectrum" (ROS) classification, which inventories the Plan Area utilizing distance from roads as the main criterion. The ROS divides the land base into the following categories

- Primitive Non-Motorized (ROS 1): >8km from a 4-wheel drive road & >5000 ha.
- Semi-Primitive Non-Motorized (ROS 2): >1km from a 4 -wheel drive road & > 1000 ha.
- Semi-Primitive Non - Motorized (ROS 3): >1 km from a 2 - wheel drive road & > 1000 ha.
- Resource Roaded (ROS 4 &5): the remaining land base, roaded and rural.

The most recent inventory of the Plan Area's Gross Land Base (GLB) shows that 2.1 million ha. (72%) in the North and 1.1 million ha. (65%) in the South are classed as ROS 1 through ROS 3, which in the opinion of some, are able to provide a similar wilderness experience. Map 14 provides a visual depiction of these areas. The data contained in Table 32 also leads to the following conclusions regarding these Primitive and Semi-Primitive lands in the Base Case:

- only marginal amounts of these less-roaded areas are in Parks or Recreation Areas, with over 95% being open to further roaded resource development in the north and south portions of the Plan Area

- only small amounts of these lands are within the THLB (4% in the North and 10% in the South) and are therefore are at risk of considerable roaded development in the foreseeable future, but it is also these areas that contain the key lower elevation recreational features/values

Table 32: Recreational Opportunities Spectrum Distribution by Base Case Zone Category

North Portion of Plan Area	
North Gross Land Base	**ROS 1 to 3 Combined**
General Management	**84%** (1,765,476 ha.)
Preservation/Retention VQOs	**1%** (32,711ha.)
Partial Retention VQOs	**7%** (145,593 ha.)
Recreation Areas	**5%** (109,457 ha.)
Parks	**2%** (52,529 ha.)
Deferrals	**2%** (52,975 ha.)
Total (ha.)	**~2.1 million ha.**
North Timber Harvesting Land Base	
General Management	**83%** (76,535 ha.)
Preservation/Retention VQOs	**4%** (3,270 ha.)
Partial Retention VQOs	**13%** (12,442 ha.)
Recreation Areas	-
Parks	-
Deferrals	**1%** (811 ha.)
Total (ha.)	**~92,000 ha.**
South Portion of Plan Area	
South Gross Land Base	**ROS 1 to 3 Combined**
General Management	**94%** (1,075,204ha.)
Preservation/Retention VQOs	**1%** (6,380 ha.)
Partial Retention VQOs	**5%** (53,457 ha.)
Parks	-
Total (ha.)	**~1.1 million ha.**
South Timber Harvesting Land Base	
General Management	**76%** (86,418 ha.)
Preservation/Retention VQOs	**1%** (1,290 ha.)
Partial Retention VQOs	**23%** (26,257)
Parks	-
Total (ha.)	**~114,000 ha.**

Source: *LCRMP GIS Database:* BC Environment, Nanaimo

4.4.5 Sport Fishing

Angling/sport fishing is certainly a form of outdoor recreation. Most anglers undertake the activity not only to harvest fish, but also to enjoy the broader recreational experience. A wide diversity of angling experiences can be created by combining equipment, services, time, location, and other factors. Fishing techniques include: trolling; mooching; jigging; casting with bait, lures and flies; and various trapping (e.g., crabs) and digging techniques (e.g., clams). The tourism/recreational activities associated with sport-fishing can be classified into the following major categories:

- Lodge activities, which typically offer all-inclusive packages comprising accommodation, meals, boat and fuel, fishing equipment, and sometimes a fishing guide who navigates and assists in catching fish; lodge packages are often three to five days in duration,
- Charter activities, which are angling packages that include boat, guide, equipment and may or may not include accommodation or meals; charter packages generally last for a half to a full day, but may include overnight accommodation if the customer desires, and
- Independent anglers, who are responsible for their own fishing gear, boat and fuel, accommodation, meals and transportation.

The sport fishing industry is the largest generator of local tourism revenue - the most recent available research estimates that total salt-water sport fishing sales revenues (equivalent to angler expenditures) in the Plan Area totaled ~$18 to $20 million in the mid 1990s (*Gislason:* 1998, Exhibit D.1), or almost one-third of the $64 million in total estimated Plan Area tourism revenues. As noted previously, these expenditures resulted in an estimated 160 seasonal jobs, of which 115 accrued to Plan Area residents; the latter figure is about one-third of overall Plan Area tourism employment and 6% of the Plan Area 1996 resident labour force.[44] Further revenues and jobs from sport fishing in the Plan Area would also accrue to residents of Vancouver Island and elsewhere in BC.

According to MSBTC's Tourism Resource Inventory, there are a total of 50 floating and land-based fishing lodges. These lodges cater mainly to affluent anglers willing to pay an all-inclusive rate in the order of of $400+ per day. Rivers Inlet, the Bella Coola River and other Central Coast areas are renowned for their large chinook and northern coho. It is also notable that the Rivers Inlet Hakai Pass Sportfishing Association operates the Shotbolt Creek hatchery, which enhances chinook salmon from the Kilbella and Chuckwalla Rivers.

Of the 50 lodges, over half are owned or operated by non-residents of the Plan Area, mainly because the locations are remote and investment capital in the Plan Area is scarce. An estimated 42 charter companies operate in the Plan Area, some of which also offer marine sight-seeing and other services. Of these known charter operators, five are based permanently in the Plan Area, although economic spin-offs to the Plan Area would occur from virtually all of these businesses.

For conservation purposes, most of the northern part of the Plan Area has been recently designated as a "Yellow Zone" under DFO's Coho Recovery Plan, which means limited coho retention for the sport fishery in some areas, but fishing for other salmon species is allowed. However, the areas around Princess Royal Island and most of the southern portion of the Plan Area are deemed to be "Special Management Zones" where there is to be no retention of coho, with some limited fishing for other salmon species being permitted.

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[44] Note that these jobs are contained within the overall ~320 tourism resident jobs estimate for the Plan Area noted in Section 4.4.2.

From a provincial perspective, a recent BC STATS analysis estimates that the Real Gross Domestic Product (RGDP) generated by the saltwater sport-fishing sector in BC averaged $148 million/yr. from 1984-89 vs. $134 million/yr. for 1990-97. For freshwater sport-fishing, the 1984-89 estimate is $128 million/yr. compared to $117 million/yr. for 1990-97.[45] Thus while the trends have been downwards, the declines have not been nearly as significant as has been the case for the commercial salmon fishery.

Also noteworthy in this discussion is a comparison of the respective economic contributions of commercial vs. sport salmon fishing in BC, as shown in Table 33. Among other things, this data indicates that with only about 3% of the overall salmon catch, the sport fishery generates approximately 50% as many jobs as the entire BC commercial salmon fishery. While the comparison is done at a provincial level, there is no reason why this information would not also have relevance to the Plan Area.

Table 33: Contributions of Saltwater Sport Fishing vs. Commercial Salmon Fishing in BC

	Saltwater Recreational Angling Economic Activity* (1994)	Average Annual Commercial Salmon Fishing Activity (1991-94)
Total BC Sales Revenues	$611 million	$745 million
Total BC Real GDP ($1992)	$136 million	$141 million
Total BC Wages & Salaries	$140 million	$170 million
Total BC Seasonal Jobs	8,625	17,385
Total BC Jobs (Person-Years)	4050	6,458
Total BC Catch (# of Salmon)	750,000	30,764,500

Sources: *ARA Consulting*: 1996, Exhibits 9.1 & A.3; *Gislason*: 1998, Exhibits 4.4 & S.5; *Unpublished Statistics*: BC Ministry of Fisheries; *BC STATS*: February, 2000.

Notes: Freshwater angling generates additional revenues and early 1990s data chosen so as to avoid the data associated with the major downturn in the commercial salmon industry.

* Approximately 90% of angling activity was directed at salmon, mainly coho and chinook.

Unfortunately, the saltwater sport fishery in BC is facing some difficult times. Supplementing the GDP estimates noted above, from 1994 to 1997, angler expenditures (on lodges, charters, and angler supply businesses) declined from $611 million and 8,625 associated direct seasonal jobs to $485 million and 7,050 jobs, at least in part due to the uncertain regulatory environment regarding allowable limits and erronenous perceptions of foreign anglers. (*Gislason et. al:* 1999) The BC Ministry of Fisheries estimates that the tidal and in-river sport fishery suffered an average 35% to 40% loss in business activity in 1998 (lost sales, bookings, revenues and jobs) as compared to 1997, in part due to federal measures aimed at coho conservation. Such measures are expected to last for the next several years. However, opportunities do exist for sport fishing operations to diversify to other species (halibut, Ling cod, rockfish, flounder, sole, etc.) as well as for compatible activities e.g. eco-tourism (sea kayaking, whale watching, adventure touring, etc.)

The Plan Area also contains significant and highly pristine freshwater angling opportunities. In particular, the Dean River is well-known for steelhead angling. In recognition of this, the BC Ministry of Fisheries has classified the Dean River as a "Class 1 Water" for which the number of angling guides and the total number of guided angler days are limited and specified in the *Wildlife Act* regulations. (The Dean River is also the only Class 1 Water in the province for which non-guided angling use is limited.) The Ministry also estimates that there are over 150 freshwater angling guides operating in the Plan Area and in the Bella Coola area alone, angling license sales average over 6,000 annually. Guided activity occurs on eleven Class 1 and Class 2 streams (i.e., highly productive trout streams, of which there are a total of 42 in BC). In addition, non-guided angling occurs on hundreds of lakes thousands of kilometers of rivers and streams.

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[45] *BC STATS*: February 2000.

At this time, no specific job count or revenue estimates are available for the freshwater component of the recreational fishery in the Plan Area. . However, the Ministry of Fisheries estimates that there are over 500,000 freshwater angler-days each year in the Cariboo-Chilcotin-Coast area (which includes most of the Plan Area but is over double its size), equal to 12% of the provincial total, and that about 70% of anglers are visiting from outside of the region.[46] Acknowledging the potential of freshwater angling, the Ministry also helps support freshwater fishing through the trout hatchery program that stocks about 120 lakes with over 2 million trout, char and kokanee throughout the the Cariboo-Chilcotin-Coast area.

4.4.6 Hunting and Guide-Outfitting

Both guided and non-guided hunting activities occur in the Plan Area, which coincides approximately with seven BC Environment Wildlife Management Units (WMUs) and eight guide-outfitter's territories. Of these guide-outfitter territories, six are in the northern portion and two in the southern portion of the Plan Area. It is understood that six of these operators have a permanent residence outside the Plan Area.

Excluding the Princess Royal Island area, the northern portion of the Plan Area is overlain by six WMUs: #5-6 (partially), #5-7, #5-8, #5-9, #5-10, and #5-11, with the latter two essentially occupying that part of Tweedsmuir Park in the Plan Area. Hunter harvest data over five years for the main species that are hunted is detailed in Table 34. The most hunter-days (i.e., hunting effort) tend to be devoted to mule deer, followed by moose, black bear, grizzly bear, and goat respectively.

Table 34: Reported Hunter-Kills and Hunter-Days* in Northern Portion of Plan Area

	1993	1994	1995	1996	1997
Grizzly Bear (WMUs 5-6, 5-7, 5-8, & 5-9 only)					
Resident	4 (75)	7 (132)	8 (109)	21 (170)	3 (86)
Non-Resident	11 (66)	8 (94)	3 (20)	2 (95)	2 (37)
Total	15 (141)	15 (226)	11 (129)	23 (265)	5 (123)
Black Bear					
Resident	17 (121)	23 (166)	12 (41)	22 (170)	23 (192)
Non-Resident	5 (56)	4 (33)	7 (82)	18 (136)	15 (120)
Total	22 (177)	27 (199)	19 (123)	40 (306)	38 (312)
Mule Deer					
Resident	56 (668)	68 (1078)	96 (1443)	40 (593)	27 (572)
Goat					
Resident	7 (67)	11 (103)	13 (100)	13 (104)	8 (54)
Non-Resident	2 (27)	2 (11)	8 (35)	8 (47)	8 (29)
Total	9 (94)	13 (114)	21 (135)	21 (151)	16 (83)
Moose (WMU's 5-6, 5-10, & 5-11 only)					
Resident	11 (819)	27 (828)	28 (712)	37 (531)	18 (429)
Non-Resident	1 (34)	2 (11)	1 (7)	2 (17)	2 (21)
Total	12 (853)	29 (839)	29 (719)	39 (548)	20 (450)

Source: BC Environment, Williams Lake * Hunter-Days shown in parentheses.

The number of animal kills in the North has been fairly stable in recent years, with harvest levels generally displaying a fairly direct relationship with the number of hunter days (i.e., hunting effort) for each species. Note there is no season for Moose in WMUs 5-7, 5-8, and 5-9 nor for Grizzly in MUs 5-10 and 5-11.

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[46] K. Culham, Ministry of Fisheries: *pers. comm.*

In the South, virtually all of that portion of the Plan Area is covered by WMUs #1-14 and #1-15. In order of hunter days, the most popular species are deer, black/grizzly bear, and goat; BC Environment reports there is only a small population of Moose in WMU #15 (Klinaklini watershed), but no hunting of this species is allowed. As in the northern portion, there seems to be a generally consistent relationship between hunter effort and the number of animal kills, as indicated in Table 35.

Table 35: Reported Hunter-Kills and Hunter-Days* in Southern Portion of Plan Area

	1993	1994	1995	1996	1997
Grizzly Bear					
Resident	3 (161)	4 (42)	3 (134)	5 (209)	3 (87)
Non-Resident	4 (33)	3 (43)	1 (21)	1 (48)	2 (39)
Total	7 (194)	7 (85)	4 (155)	6 (257)	5 (126)
Black Bear					
Resident	30 (189)	17 (68)	10 (75)	16 (117)	0 (56)
Non-Resident	8 (49)	1 (20)	7 (38)	6 (79)	12 (71)
Total	38 (238)	18 (88)	17 (113)	22 (196)	12 (127)
Deer					
Resident	242 (1552)	242 (1435)	273 (1537)	267 (1976)	230 (1357)
Non-Resident	0 (0)	1 (6)	1 (15)	2 (69)	5 (43)
Total	242 (1552)	243 (1441)	274 (1552)	269 (2045)	235 (1400)
Goat					
Resident	2 (28)	3 (28)	2 (11)	2 (30)	3 (16)
Non-Resident	2 (7)	2 (13)	1 (3)	1 (8)	0 (0)
Total	4 (35)	5 (41)	3 (14)	3 (38)	3 (16)

Source: BC Environment, Nanaimo.
* Hunter-Days shown in parentheses.

Data to indicate the social/economic signficance of hunting and guide-outifitting to the Plan Area are not available. However, it is known that hunting is an very important part of the subsistence economy to many individuals in the Plan Area, primarily members of First Nations.

4.4.7 Trapping

Trapping is undertaken in the Plan Area primarily by First Nations, for both cultural (e.g., the design of regalia) and economic purposes. In the North, the most prevalent species trapped are Marten, Beaver, Muskrat, and Mink. Table 36 outlines the reported kills on an annual basis, but it is understood that much trapping activity goes unreported. Subject to the reliability of the data, it appears the number of kills for Marten and Mink has declined quite dramatically in past years. And if the number of kills has fallen, since there is no data on trapping effort, it may simply be the case that markets or other factors have reduced interest in trapping. On the other hand, if trapping effort has remained constant or has increased, a stronger case can be made that populations of these furbearers are declining in the northern portion of the Plan Area. Other species trapped include Fisher, Coyote, Fox, Lynx, Otter, Squirrel, and Weasel.

Table 36: Wildfur Harvest in Northern Portion of Plan Area

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Marten	714	496	298	531	137	71	152	96	137	79

Beaver	54	87	42	36	17	22	49	21	68	69
Mink	97	101	28	43	12	11	7	9	37	9
Muskrat	40	76	6	53	5	29	30	12	11	11

Source: BC Environment, Williams Lake.

In the southern portion, there are over 90 traplines, and about one-third are classified as being "active," with most of the rest being held by aboriginals and classified as being "inactive" or "non-reporting." The trend towards lower reported harvests in recent years is similar to that in the northern portion of the Plan Area, especially for marten. In addition to the species noted in Table 37, others trapped include beaver, squirrel, and weasel.

Table 37: Wildfur Harvest in Southern Portion of Plan Area

	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Marten	398	216	47	172	45	62	52	6	56	-
Mink	43	61	30	85	31	38	37	9	2	-
Raccoon	23	26	4	3	8	6	12	12	3	-
Otter	11	15	3	20	12	10	8	5	6	2

Source: BC Environment, Nanaimo.

While trapping is not a large component of the Plan Area economy (statistics on trapping's contribution are not available) it is a part-time supplement to other income sources for many aboriginals.

4.4.8 Outlook for Tourism and Recreation

Although the recreational resources of the Plan Area can be difficult to access, their relative isolation is very appealing to that segment of modern society which makes an effort to seek out relatively unknown and unspoiled recreation destinations. It is likely that the pristine quality of many wilderness values that are important to guide-outfitters, backcountry recreationists, kayakers, etc. are likely to continue to gradually decline over the long term (due to timber harvesting, aquaculture siting, mining, etc.) Examples of areas believed to be threatened due to resource development are Johnstone Strait and Hakai Pass. (*Price Waterhouse & ARA*: 1996, p. B4-3) Exactly when such a deterioration in these values would cause an actual decline in recreation and tourism activity cannot be predicted, however such an effect is not likely to occur in the forseeable future. Therefore, it is still expected that "eco-tourism" and the use of recreational resources in the Plan Area will increase at a modest pace for a considerable period.[47] This is due to the fact that the "supply" of wilderness values in the Plan Area is vast relative to the rate at which it is being compromised. Moreover, while currently pristine areas will be subject to development which may discourage some users, that same development makes such areas more accessible to others who are less concerned with visual and other associated impacts; this includes the potential impacts that recreationists may have on each other, in the absence of some sort of demand-side rationing (e.g., the reservation system on the West Coast Trail, Bowron Lakes, etc.)

The outlook for the saltwater sport salmon fishing sector will continue to be unstable, and partly depends in on the regulatory environment, e.g., timely announcements of catch limits and other rules. On the positive side, the recently announced DFO policy of providing priority access to chinook and coho for angling should provide more business certainty for the sport fishing sector. Avenues for sport fishing operators to improve their revenue base and profitability include extending the operating season to get greater utilization of fixed assets. This may involve offering non-traditional angling products (e.g., bottom-fishing) or may involve offering eco-tourism and other non-fishing services during the shoulder periods. According to the BC Ministry of Fisheries, such developments are likely to include increased product diversification (e.g., sport fishing for groundfish, fly fishing for salmon, etc.), joint ventures with eco-tourism operators, and improved community infrastructure to better support sport fishing (e.g., boat ramps, piers, etc.).

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[47] For example, outdoor adventure tourism continues to grow in BC even though there are more forestry roads and clear-cuts each year and *Shaffer* (1997: p. 38) concludes that marine tourism in the Broughton area has grown despite the negative aesthetic impacts of fish farms.

At the provincial level, it is clear that tourism is one of the BC economy's consistent growth sectors. For example, according to Tourism BC, annual visitation and revenues from 1992-1997 grew from 18.2 million overnight visits and $5.5 billion to 21.3 million overnight visits and $8.5 billion; from 1989-96, tourism related employment grew by 20%. About 7% of all BC tourism businesses offer adventure tourism products akin to the type of tourism most prevalent in the Plan Area. Tourism BC also reports that from 1996-97, an 11.1% job growth rate in adventure tourism jobs was the highest rate of all the tourism sub-sectors. In terms of visitor volumes, it is reported for 1994 that the key land-based outdoor tourism activities were outdoor accommodation (e.g., camping), hunting, trail riding, biking/hiking, guide-outfitting trips, and hut-to-hut. The most popular water-based outdoor tourism activities were power/sail cruising, wildlife viewing, kayaking, river-rafting, and scuba-diving; collectively, 2,885,490 overnight visits accrued from these activities in 1994, or about 15% of total overnight visits in BC that year. (Note that these figures exclude sport fishing.) This same source also estimates that water-based tourism revenues in BC is expected to grow at about 10% annually in the short term, while the figure for land-based revenues (excluding hunting) is about 5% (*Price Waterhouse & ARA*: 1996, pp. B4-6, B4-8).

There is no reason not to expect these trends to continue into the forseeable future, both provincially and within the Plan Area, even under the Base Case management regime. In the longer term, certain pristine wilderness values will be compromised; however, the socio-economic effects of which are very uncertain.

4.5 Agriculture

4.5.1 Background and Recent Trends

While the soil in the Plan Area is generally not suited for agriculture, a small amount of farm land exists within the Bella Coola Valley. In fact, over 4,400 hectares of land in the Central Coast Regional District (comparable to the northern portion of the Plan Area) is within the Agricultural Land Reserve (ALR), according to Agricultural Land Commission staff. Before Highway #20 was completed from Williams Lake in 1953, this area served several coastal communities with agricultural products. However, with the increased transportation linkages since that time, the resulting food imports have contributed to declining agricultural development.

As of 1996, there were 30 farms (on 2,810 hectares and reporting gross farm receipts of $392,356), an increase from the 1991 total of 18 farms.[48] This increase is consistent with the Census labor force data, which indicates an increase in local farming jobs during the same period, from 5 in 1991 to 40 in 1996; most recently, agriculture accounted for about 1% of personal income in the Plan Area (see Table 9 in Section 3.2). Of the 30 farms, 11 are classified as "Miscellaneous Specialty," five are "Beef Cattle," and three are "Field Crops."

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[48] *Census of Agriculture Statistics for Regional Districts in BC - 1991 & 1996*: Ministry of Agriculture and Food, 1997.

There is potential for growth in organic farming and market gardening in the Bella Coola Valley, since the area has not been significantly affected by industrial or urban development and much of the agricultural land has been fallow for over 30 years. For example, a successful local farmer's market has developed over the past few years.

There are very few range tenures within the Plan Area. According to MoF, there are six grazing permits that cover approximately 2,146 ha surrounding the Bella Coola Valley. There are no other grazing permits/licenses or hay cutting permits/licenses issued for the remainder of the Plan Area. During 1996, the Plan Area provided 171 annual Animal Unit Months (AUMs) of range land to local farmers for grazing purposes.[49] In 1996, there were a reported 161 head of cattle and ten horses in the Plan Area.

4.5.2 Outlook

As noted above, the numbers of farms increased from 1991 to 1996. While limited growth may continue, economic growth in this sector is primarily driven by market and cost factors, and the location/soils of the Plan Area make it unlikely that agriculture will be a significant contributor of local jobs in the future. Over the past five years, the number of grazing permits in the Plan Area has not changed and it seems likely that this stability will continue. MoF has encouraged tenure holders to convert short-term permits to longer-term permits in response to the 1989 Range Program Review. The Forest Practices Code will affect range management, in that it increases the responsibility of tenure holders to develop Range Use Plans and thus creates a need for training in the preparation of such plans. Greater emphasis will be placed on the integrated use of range, however, this will generally not be as complex an issue for the Central Coast Plan Area as it may be for other regions of the province, since range conflicts with other values are minimal.

4.6 Mining and Energy

4.6.1 Background and Recent Trends

There are presently no operating mines, advanced exploration activities, significant energy projects, or existing metal mining/energy resident employment in the Plan Area. As a result, current resident mining/energy employment and related personal income is close to zero, although there may be some exploration activity which is primarily undertaken by individuals who reside outside of the Plan Area. There are also minor amounts of sand/gravel and hydro-electricity production occurring and a proposed aggregate quarry. The Ministry of Energy and Mines (MEM) considers the Plan Area to be "under-explored" vs. many other BC areas (due to difficult terrain and lack of roads) and therefore stresses that the mineral potential has not been adequately assessed. In spite of the uncertainties involved, MEM has identified "tracts" of similar geology based on the current understanding of the distribution of mineral deposits and has ranked them with respect to the probability of a mineral deposit discovery. The MEM mineral potential mapping for the Plan Area indicates that most of the mineral potential of the inland region ranges from low to moderate from a provincial standpoint. Map 15 shows how this potential is distributed throughout the Plan Area.

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[49] One "Animal Unit Month" is the amount of forage required to support a 454 kilogram cow, either dry or with calf up to six months of age, for one month.

MEM also operates the MINFILE database, which reports 67 mineral "occurrences"[50] in the northern portion of the Plan Area and 59 in the South. Map 16 shows the location of these occurrences. Other MEM mapping done for the LCRMP includes tenure[51] location and geothermal potential, as shown in Table 38, which overlays these indicators on the Base Case zones.

Table 38: Distribution of Mineral/Energy Potential Areas by Base Case Zone Category

Mineral/Energy Indicator	General Management	VQOs	Existing Parks	Recreation Areas	Total
North Portion of Plan Area					
High Metallic Mineral Potential (ha.)	35%	1%	63%	0%	104,045
High Industrial Mineral Potential (ha.)	90%	9%	0%	0%	280,729
Developed Prospects (#)	100%	0%	0%	0%	1
Past Producers (#)	60%	40%	0%	0%	10
Other Mineral Occurrences (#)	54%	34%	7%	2%	56
Mineral Tenures (ha.)	87%	13%	0%	0%	5,651
High Geothermal Potential (ha.)	73%	27%	0%	0%	278,329
South Portion of Plan Area					
High Metallic Mineral Potential (ha.)	93%	7%	0%	-	288,415
High Industrial Mineral Potential (ha.)	76%	24%	0%	-	120,493
Developed Prospects (#)	100%	0%	0%	-	1
Past Producers (#)	25%	75%	0%	-	12
Other Mineral Occurrences (#)	57%	43%	0%	-	46
Mineral Tenures (ha.)	76%	24%	0%	-	9,997
High Geothermal Potential (ha.)*	n/a	n/a	n/a	-	n/a

Source: *LCRMP GIS Database:* BC Environment, Nanaimo

* Geothermal potential mapping for the South was not available (n/a).

Key conclusions drawn from the information in Table 38 are:

- In the north portion of the Plan Area, 63% of Highest Metallic Mineral Potential Lands are contained in existing provincial parks
- Also in the north, 27% of High Geothermal Potential Lands, 40% of Past Producing mines, and 34% of "Other Mineral Occurrences" are contained in Preservation/Retention/Partial RetentionVQO zones, where development might be more costly
- The latter issue is even more striking in the South, where higher amounts of Past Producers (75%), Mineral Tenures (48%), "Other Mineral Occurrences" (43%), High Industrial Mineral Potential Lands (24%), are within Preservation/Retention/Partial Retention VQOs

Past producing mines are sometimes significant in that they can provide opportunities for further development, e.g., in 1986 a proposal was made to re-activate the Surf Inlet and Pugsley "Past Producers" (gold/silver) mines on Princess Royal Island; this would have employed about 60 workers, but activity did not materialize. In addition to these, other relatively significant metallic Past Producers include Doratha Morton (gold/silver) on Loughborough Inlet, Nugent and Alexandria (gold/silver) on Seymour Inlet, and Western Copper (gold/silver/copper) in the Khutze Study Area (i.e., a candidate Protected

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[50] Mineral occurrences are organized in an hierarchy of significance, from "Showings" (i.e., occurrences of mineralization insufficiently defined to permit resource estimation) to "Developed Prospects" (i.e., occurrences with sufficient mineralization for a numerical estimate of ore grades/tonnages) - the latter category is assumed to have the highest probability of becoming a mine, although "Past Producers" can also become economic again.

[51] Note that mineral tenures are largely transitory and thus only show currently active areas.

Area.) Other areas deemed to have significant metallic potential by MEM are the Franklin Glacier area and in the vicinity of the Noosegulch River near Hagensborg.[52]

Of the 126 documented mineral occurrences in the Plan Area, 34 are industrial minerals (i.e., limestone, clay, magnetite, graphite, clay, asbestos, dimension stone, sand/gravel, etc.) Locations where there has been past production include within the Koeye River Study Area (limestone), Cunningham Island (limestone), Aristazabal Island (limestone), King Island (clay), (clay), Matsiu Creek (dimension stone), and Hunter Island in the Hakai Recreation Area. There is also some current sand/gravel activity near Bella Coola, including a proposal for an aggregate quarry near the community.

The primary source of energy locally is electric power supplied by stand-alone hydro and diesel generators, since the Plan Area is not connected to the BC Hydro grid. Small scale hydro-electric sources include Clayton Falls hydroelectric generating station near Bella Coola and the Central Coast Power Corporation facility at Ocean Falls. Diesel plants are located in Bella Coola and Bella Bella but there are no significant power generation facilities known to be located in the south portion of the Plan Area.

There is also potential for geothermal energy use (i.e., heat energy from the earth) in the Plan Area. For example, MEM reports four documented hotsprings: Kelkane (on the mainland, opposite Princess Royal Island) Eucott and Nascall (on Dean Channel), and Tallheo (on South Bentinck Arm). There is additional potential elsewhere, as indicted by the MEM geothermal mapping. MEM notes that those geothermal sources not suitable for electricity generation could have possibilities for tourism and heating uses. While geothermal energy is not in common use currently in BC, it is utilized to some extent in the US, Japan, Italy, Iceland, and other countries.

There are no petroleum-related activities, due both to the low potential in the terrestrial portion and also because there is currently a government moratorium on off-shore exploration and development. Regarding the latter, there is considerable potential for extraction of oil and natural gas off of the Central Coast in Queen Charlotte Sound and Hecate Strait. The Geological Survey of Canada estimates that the range of resource potential is 6.3 to 19.4 billion barrels (bbls.) of "in-place" oil and 12 to 48 Trillion Cubic Feet (TCF) of "in-place" gas,[53] which according to MEM staff, is about 10 times as much oil and one-third as much gas as exists in north-east BC. Currently, most of the area from the northern tip of Vancouver Island to Dixon Entrance is covered by exploration licenses. Within the past year, there has been renewed interest by some in BC (mainly in the northwest) for a lifting of the moratorium and the provincial government has undertaken some formal consultation on the issue via the office of the Northern Development Commissioner.

4.6.2 Outlook

As noted previously, it is the Developed Prospects that are assumed to represent the "best chance" for a future mine (for which MEM identifies only two in the Plan Area), although probability and timing of any development of any mineral occurrence is highly uncertain. According to MEM, there are about 12,000 mineral occurrences in BC, of which almost 10,000 are metallic. Of these metallic occurrences, 6 of 119 developed precious metal prospects and 8 of 233 developed base metal prospects are current operating mines. In addition, over 1500 metallic occurrences were past producing mines, although the vast majority would have been quite small employers. These statistics provide some indication of the odds of metallic properties proceeding to development, at least in the short term. Also, specific to the Plan Area, the relatively low amount of roaded access and the fact that the Central Coast is not connected to the BC Hydro power grid are key obstacles that inhibit development. Taking this information into consideration leads to the conclusion that the Plan Area's metal mining employment is not expected to grow significantly in the near future; however, over the longer term new metal mines could in fact be developed. More immediately, an aggregate quarry project near Bella Coola may soon enter the *BC Environmental Assessment* process; the proponent estimates that 42 direct jobs would be created at the quarry alone if the project comes to fruition, potentially lasting for many decades.

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[52] Most of this information is excerpted from *A Preliminary Assessment of the Mineral and Energy Resources of the Central Coast Region, BC*: R. Pinsent, Ministry of Energy and Mines, 1998.

[53] *Petroleum Resource Potential of Sedimentary Basins on the Pacific Margin of Canada and the Queen Charlotte Basin*: Hannigan, Dietrich, Lee, & Osadetz, Geological Survey of Canada Open File 3629, July 1998, p. 34. Note the lower end of the range is described as having a 90% probability and the upper end having a 10% probability. In addition, note that "in-place" estimates are larger than the amount of the petroleum resource that can be economically extracted with current technology.

At the provincial level, the short-term outlook for mining is not optimistic due to problems with industry investor confidence, which is influenced by variables such as current low mineral prices relative to historic levels, the tax regime, aboriginal land claims, risk capital flowing to other sectors (e.g., high technology), in addition to negative industry perceptions about provincial land use initiatives. However, if a significant Central Coast mineral discovery does proceed to development, it would provide considerable local employment through each mining phase (i.e., exploration, evaluation, development, and operation). Employment can range from under 20 in small quarries to several hundred in large base metal mines, and mine reserves can last for over 20 years.

As for energy, development of additional electricity generation in the Plan Area is limited by the area's modest population. However, there are a number of identified river systems throughout the Central Coast area that have the capability to generate electricity. In addition, the Ocean Falls plant has excess electrical capability of approximately 10 MW.

If the offshore oil and gas exploration moratorium were withdrawn, there would likely be some socio-economic benefits for Plan Area residents (as well as those of the North Coast, Queen Charlotte Islands and northern Vancouver Island), depending on how the resource was developed, source of labour hired, extent of the use of services in smaller coastal communities, etc. There are some concerns that new marine and terrestrial Protected Areas would either preclude some of this potential or result in less mainland access for "staging areas." But given that new marine Protected Areas would be located quite close to coastal shorelines while the petroleum resource is located much further offshore and that only a relatively low proportion of the coast is likely to become either marine or terrestrial Protected Areas, it is unlikely that such areas will result in significant amounts, if any, of foregone petroleum-related activity.

4.7 Botanical Forest Products

4.7.1 Background and Recent Trends

In the past, botanical forest products (e.g., edible and medical plants) have received little attention from a commercial standpoint due to the emphasis on forests mainly as a source for timber. However, as the value and market potential of non-timber forest products have increased, they have gained more prominence. Marketable forest products found in the Plan Area include pine mushrooms, western yew bark, cedar oil, morel and chanterelle mushrooms, floral greenery, and various botanical medical items. In fact, one entrepreneur is currently manufacturing marketing medicinal ointments to destinations outside of the Plan Area. Many botanicals also have a special cultural and/or spiritual significance to First Nations.

The most well-known commercial botanical product in the Plan Area is the pine mushroom, which is mostly exported to Japan. Pine mushrooms are generally found in the the Bella Coola-Dean River-Tweedsmuir Park areas (although mushroom harvesting is not officially allowed in Parks or Recreation Areas), North and South Bentinck, and Oweekeno Lake and usually occur in older forests of 100 to 200 years. While prices vary by quality, the average market value of the pine mushroom has recently been $10 to $15 per pound, however, spot prices in the past have been as high as $100-200 per pound for the higher grades.[54] The harvesting season of pine mushrooms is relatively short, typically from mid-September to the end of October. Pine mushroom picking is a source of income for many residents in the Central Coast, as well as some non-residents. In 1999 there was an estimated 100 tonnes of pine mushrooms shipped out to Japan from the Plan Area[55] but no published economic statistics are available.

Wild berry picking also provides some local seasonal incomes. The most well known of such native plants are wild blueberries, blackberries, and strawberries and have historically been a part of First Nation diets.

4.7.2 Outlook

The traditional and commercial harvesting of botanical forest products raises many issues, such as ecosystem sustainability, land use conflicts, allocation of the resources among users, government revenue collection, complexity of administration, illegal harvesting in parks, etc. There is currently no provincial policy covering botanical forest products, although MoF has been studying the issue for several years. Sections 104 and 216 of the *Forest Practices Code* enable the government to make regulations regarding the buying and licensing of buyers for botanical forest products, but no regulations are yet in place.

There are specific concerns over potentially decreasing future pine mushroom yields due to the rates of clear-cut timber harvesting in the Plan Area - the research indicates that the species tends to prosper under more selective harvesting regimes, but not necessarily always in closed-canopy forests. Based on input from MoF, it is assumed in the analysis that pine mushroom growth tends to occur mainly in the Coastal Western Hemlock (CWH) biogeoclimatic zone variants within dry fir/pine leading stands. Map 17 shows where these sites are in the Plan Area. Using this information, Table 39 depicts how these stands are distributed among the Base Case zones for both the Gross Land Base (GLB) and the Timber Harvesting Land Base (THLB), but without more information as to the specific management requirements of pine mushrooms, statements on future trends are difficult to make. However, two observations about the data can be made:

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[54] *Botanical Forest Products in British Columbia - An Overview*. Ministry of Forests, April 1995.

[55] Pacific Coastal Airlines staff: January 2000, *pers. comm.*

- According to the *Mid Coast TSA Timber Supply Review* (June: 1999), in 100 years, virtually all of the THLB will contain stands less than 120 years old, probably not unlike most other areas of the Coast;

- However, a significant amount of "Forested Exclusions" (i.e., areas outside of the THLB but with forest cover) is covered by the dry fir/pine CWH variant, which may contain appropriate pine mushroom growing sites.

Table 39: Distribution of Fir/Pine Stands in Dry CWH Variants by Base Case Zone Category

Base Case Land Use Zone	North			South	
	GLB	THLB		GLB	THLB
General Management	39%	31%		90%	73%
VQO Areas	27%	69%		10%	28%
Deferrals	1%	0%		-	-
Parks	33%	0%		0%	0%
Recreation Areas	0%	0%		-	-
Total CWH Dry Fir/Pine Stands (ha.)	**15,384**	**2,155**		**11,777**	**2,553**

Source: *LCRMP GIS Database:* BC Environment, Nanaimo

Pine mushroom prices may not in the near future reach the heights seen in the past, since the supply from other countries is increasing (i.e., China and Korea), and the lingering Asian financial situation is likely to continue to dampen demand. However, it is likely that as the economic problems in Asia subside over the next several years, demand for imported pine mushrooms will continue to increase, since Japan's domestic supply is continuing to decrease due to problems in its red pine forests.

In general, utilization of botanical forest products is growing, and a recent independent study concluded there are major economic opportunities in BC for increased botanical forest products exports.[56] However, without more specific information on botanicals in the Plan Area, future trends from a local standpoint are very difficult to judge.

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[56] *An Economic Strategy to Develop Non-Timber Forest Products and Services in BC*: R. Wills & R. Lipsey, FRBC Project No. PA97538-ORE, March 1999.

5. LAND & RESOURCE USE PERSPECTIVES

The following section presents a description of miscellaneous stakeholder and First Nations opinions on land and resource concerns and are not to be construed as the views of the authors of this report. These quotes were collected randomly by G.E. Bridges and Associates by talking to various stakeholders before the LCRMP process began, and therefore do not purport to present any "majority opinions." Note also that while the individual quotes have been summarized, editing has been kept to a minimum. These comments are included to inform readers of some of the key concerns of the major stakeholders and First Nations who have interests in the Plan Area. This is because, as per the government's *Social and Economic Impact Assessment of LRMP in BC: Interim Guidelines* (1993), analysts are encouraged to take local concerns into account in undertaking the socio-economic analysis for LRMPs. The "resident perspectives" section attempts to represent the concerns of those who live in the Plan Area, while the "non-resident perspectives" section attempts to represent the concerns of those who have interests in the region but who live outside of the Plan Area.

5.1 Resident Perspectives

5.1.1 Environmental

- *Logging should take place in already disturbed areas and timber should be remanufactured locally to provide a strong local economy. Ecologically significant rainforest areas should remain intact. There should be no cap on the amount of Protected Areas in the planning area.*
- *In order for local communities to benefit from their surrounding land base, the fundamental issues of tenure reform and AAC must be addressed. However, since the LCRMP does not address these issues, the process will not provide any opportunities for tenure reform, etc.*

5.1.2 Industry

- *The significance of local employment dependence on the forest land base should be fully evaluated. Currently, few local benefits are generated by the timber harvested in the area. Essentially the region is an extraction zone.*
- *A stable and viable Small Business Forest Enterprise Program supporting more value-added activities is essential to generating more local benefits from the forest land base. Value-added projects must be labour intensive and not require a large amount of investment capital or power.*
- *Some form of community based tenure is needed to encourage long-term socio-economic stability. A balanced emphasis is needed between First Nations and non-First Nations land based management strategies.*
- *Allocation of timber from this area should be first to local operators. The present system of short term timber sales is not a secure enough base upon which to establish long term local ventures.*
- *Regarding the tourism industry, the LCRMP process should ensure that access to, and the use of natural resources for tourism be maintained.*
- *The LCRMP process should ensure that land use decisions do not adversely impact current salmon production levels. Logging in the Neekas River/Spiller Channel area will impact the chum producing potential of this system, while allowing logging in the Martin River will impact the coho producing potential of this system.*

- *Log dumps and storage areas should be located away from estuaries and herring spawning locations so as to maintain the health of juvenile salmon and herring. In addition, the impact of logging activities on sockeye levels in Rivers Inlet should be considered.*
- *Develop policies and programs that protect the sport fishing industry (e.g., fishery enhancement, limiting commercial fishing, etc.)*

5.1.3 Community & First Nations

- *Although the Forest Practices Code protects visual quality along the Inside Passage, there is concern regarding the need to protect the scenic corridor travelled by the Plan Area's new ferry operation.*
- *Communities in the Central Coast need an improved economic framework, whereby more benefits from resource development accrue to local residents.*
- *Due to the low local tax base, it is difficult for the communities to afford good social programs and education facilities - skills training is needed.*
- *The LCRMP process should address land and resource issues that directly impact the employment and economic development opportunities of First Nation (e.g., access to timber supply, protection of access to traditional fishing areas, etc.).*
- *The protection of sockeye habitat is very important to area First Nations. While these groups are actively pursuing enhancement techniques to increase sockeye production to meet their food, ceremonial, and social needs, current productions levels are still inadequate.*
- *Herring spawn-on-kelp is a traditional source of food for First Nations in the planning area and it is important that the traditional beaches and foreshore areas where this food is harvested not be used for alternative purposes (e.g., booming or dumping areas).*
- *The need to improve the access of First Nations to timber supply so as to enhance employment opportunities. The current Small Business Forest Enterprise (SBFEP), for example, offers only limited timber supply opportunities for First Nations as they are rarely awarded an SBFEP contract. In addition, First Nations are not given the opportunity to take advantage of other sources of fibre supply such as the undercuts of the major TFL holders. To help address this issue, the LCRMP process could pursue the establishment of a policy which allowed undercuts to be designated specifically for the use of First Nations.*

5.2 Non-Resident Perspectives

The following reflects some of the concerns of those who have interests in the Plan Area but who, generally, reside outside of the region. This includes some First Nations (primarily members of the Musgamagw Tsawataineuk Tribal Council and Kwakiutl District Council) who claim historical ties to portions of the Plan Area via the existence of traditional territories there.

5.2.1 Environmental

- *Pristine old growth rainforests should be left undisturbed and remain free of ecological destruction by industrial clear cutting.*
- *Articles on areas within the Plan Area are raising international environmental awareness of the Central Coast and increasing the need to get on with the LCRMP process (e.g., the recent article in Audubon by the Round River Conservation Group regarding Ellerslie Lake).*
- *Improved access to the Central Coast provided by the new ferry service will increase public awareness of environmental values that need to be protected.*

5.2.2 Industry

- *Many forest companies would like the land claims issues settled so they can begin to develop long term relationships with First Nations.*
- *An LCRMP process which develops a zoning system consistent with the province's goals for sustainable development will benefit the forest industry. This process should recognise that sustainable family-wage jobs must continue, both in communities in the region and elsewhere.*
- *The Protected Areas must recognise the low level of forest operability in the Central Coast. The LCRMP zoning process must have clear objectives and guidelines that permit the industry to operate with certainty, efficiency and in a cost-effective manner.*
- *The LCRMP process should ensure that the integrity of important tourism viewscapes (e.g., around lodges, along ferry routes) and high use tourism areas (e.g., the Broughton Archipelago) are protected.*
- *Although there is some support for the Protected Areas goal of 12.0%, a greater level would impose unacceptable hardship on the forest industry given current operability difficulties and other management constraints. The AAC could be increased with allocation of Enhanced Forestry Zones in more productive area, by allowing some relaxation of adjacency and visual constraints in these areas.*
- *The negative impact of current logging practices on the production of sockeye in the Owikeno Lake streams and in the Long Lake watershed area needs to be addressed.*
- *Long-term leases should be made available to tourism operators (based on performance or economic factors) so as to provide security of tenure. A fair and simple system for securing lease rights to Crown land needs to be developed.*
- *The LCRMP process should develop clear and fair guidelines for tourism use of Protected Areas including the use of helicopters to access Protected Areas.*
- *Non-Plan Area residents (e.g., those living on Northern Vancouver Island) are likely to place as much importance on having a job in the Plan Area as are Central Coast residents.*

5.2.3 Community & First Nations

- *Communities outside of the Plan Area that benefit from the area's natural resources and from supplying goods and services to resource processing and tourism industries in the region have much at stake in this process. In fact, some of these communities may have more at stake in the LCRMP process than communities within the planning area.*
- *Communities on Northern Vancouver Island emphasize the critical importance of keeping the Plan Area open for resource extraction, forestry and aquaculture.*
- *The rights of First Nations to fish for food, social and ceremonial purposes should take precedence over allocations of fish to the commercial and sport fishery. As a result, it is necessary to ensure that land use decisions do not diminish fish production.*

6. Appendices

(Following Pages)

APPENDIX A: METHODOLOGY FOR TOURISM INCOME/EMPLOYMENT ANALYSIS

Due to the difficulties associated with quantifying the economic contribution of tourism from a supplier perspective (e.g., lack of data, compleixties involved in obtaining revenue data from operators, and the difficulty of distinguishing between tourist and resident use of recreation resources), G.E. Bridges & Associates opted to use an alternative approach to estimating tourism's contribution to the local economy. This involved using visitor expenditure profile data and regional room and campground revenue data to determine the estimated value of Plan Area visitor spending in 1996. Although this methodology is a defensible way of estimating the value of tourism, its major limitation is that it does not account for visitors who, for example, arrive in the region (e.g., by pleasure boat or kayak) and camp on land other than provincial parks and recreation sites. However, from an economic impact perspective, however, this omission is unlikely to be significant as these visitors are likely to undertake significant expenditures in the Plan Area.

The economic analysis of tourism in the Central Coast Plan Area therefore involved the following steps:

- Room revenue data for the region was requested from BC STATS. Because only 14 (23%) of the estimated 61 fixed roof accommodation properties in the region are included in room revenue figures for the area (the remainder have mailing addresses outside the region), estimating total Plan Area room revenue was done based on the following calculations: $946,000 (1996 room revenue for 14 properties) x 1/0.23 = $4,113,043 million. (Note that 1998 room revenue was virtually identical at $959,000.)

- BC Parks data was used to determine the amount visitors spent to stay in provincial parks. The average occupancy rates of the public campgrounds was applied against the total number of private campground sites in the Plan Area (the accuracy of this rate was confirmed by a private campground operator). The result was then multiplied by an average campsite nightly fee (from the BC Accommodation Directory) to determine the amount visitors spent to stay in the area's private campgrounds in 1996.

- Estimates of occupancy and average room revenue were applied against the total number of Bed and Breakfast units in the Plan Area to determine the amount visitors spent to stay in area B & Bs. (B & Bs with less than four rooms are not included in provincial room revenue estimates.)

- The above three sets of figures were summed to provide an estimate of the total amount which visitors to the area spent on accommodation in 1996. Using this accommodation spending data as a base, the proportional spending breakdowns provided in the Vancouver Island/Coast Tourism Development Strategy for the Central Coast region were applied against the accommodation spending figure to estimate total visitor spending as shown in Table A-1.

Table A-1: 1996 Central Coast LCRMP Plan Area Accommodation Revenue Estimate

Accommodation Category	Derivation	Spending Estimate
Fixed Roof (including Lodges)	1996 Room Revenue Tax database information	$4,113,043
Provincial Campgrounds	2,013 visitor party nights x $9.50 (1996)	$19,124
Private Campgrounds	110 sites (est.) x 180 day operating season x 35% occupancy x $14.00/night	$97,020
B&Bs (less than 4 units)	12 units (est.) x 120 day operating season x 35% occupancy x $50.00/night	$25,200
TOTAL		**$4,254,387***

- Total 1996 Central Coast visitor spending estimates by category are provided in Table A-2. As the figures indicate, accommodation accounts for a relatively small proportion of Plan Area visitor expenditures (6.8%). It should be noted that although homes of friends and relatives is not included as a category in the Table, the accommodation percentage in column two accounts for this accommodation category and, therefore, has no impact on the spending calculations presented in third column. In any event, the homes of family and friends account for only a negligible proportion of total visitor nights.

Table A-2: 1996 Total Plan Area Tourism Spending Estimate

Spending Category	Proportion of Visitor Spending[57]	Total Spending Estimate ($ million)
Accommodation	6.8%	4.3
Auto Transportation	6.7%	4.3
Other Transportation	24.9%	16.0
Package/Cruise	53.5%	34.2
Restaurants	4.7%	3.0
Groceries	1.9%	1.2
Recreation	0.7%	0.4
Shopping/Souvenirs	0.1%	0.1
Other	0.7%	0.4
TOTAL	**100%**	**$64**

- Using the information from Tables A-1 and A-2, Table A-3 then estimates the approximate number of jobs in the Central Coast tourism industry.

Table A-3: 1996 Estimated Central Coast Visitor Spending Income and Employment Contributions

Spending Category	% of Visitor Spending	Amount Spent ($Millions)	% Spent going to wages[58]	Average Wage[59]	Number of Direct Jobs (Resident & Non-Resident)
Accommodation	6.8%	$4.3	25.0%	$10/hr. ($18,000/yr.)	61
Vehicle Service (Auto)	6.7%	$4.3	9.6%	$12/hr. ($21,600/yr.)[60]	19
Other Transportation (i.e., air)	24.9%	$16.0	32.0%	$55,000/yr.	93
Package (e.g., guiding services)	53.5%	$34.2	22.4%	$26,000/yr.	295
Restaurants	4.7%	$3.0	30.0%	$9.00/hr. ($16,200/yr.)	56
Retail (Groceries, shopping, souvenirs & other)	2.7%	$1.7	15.0%	$11/hr. ($19,800/yr.)	13
Recreation	0.7%	$0.4	15%[61]	$10/hr. ($18,000/yr.)	3
TOTAL	**100%**	**$64.0**	--	--	**540**

APPENDIX D Cabinet Approved Study Areas in the GLB and THLB

STUDY AREA	**Goal**	**Forum**	**GLB**	**THLB**
AITKEN ISLANDS	2	North		
a Early (ha) AC = 0,1,2			1	
a Mature (ha) AC = 5-8			5	
Total			**6**	
c Low Site Productivity (ha) (0,5,10)			6	

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[57] These spending breakdowns were obtained from a special run of Visitor '89 spending data for visitors to the Central Coast. These figures are reported in the *1991 Vancouver Island/Coast Tourism Development Strategy.*

[58] From *Small Business Profiles* prepared by BC STATS.

[59] From labour market occupation information prepared by Human Resources Development Canada. The wage rates presented were averaged by comparing high and low union (where applicable) and non-union rates and multiplying this average by 1,800 hours - the average number of hours worked annually by a full-time employee.

[60] Combination of service station attendant and mechanic wage rates.

[61] For the purposes of this analysis, the average for Boat Rentals and Marinas has been used.

Total			**6**	
ASHLUM	1	North		
a Early (ha) AC = 0,1,2			5281	26
a Mature (ha) AC = 5-8			1075	334
a Mid (ha) AC = 3,4			138	16
a Old (ha) AC = 9			1761	294
Total			**8254**	**670**
b Early Volume (m3)			2966	2627
b Mature Volume (m3)			481421	247124
b Mid Volume (m3)			13659	2941
b Old Volume (m3)			698657	231324
Total			**1196703**	**484016**
c Good Site Productivity (ha) (>25)			73	62
c Low Site Productivity (ha) (0,5,10)			6636	
c Medium Site Productivity (ha) (20-25)			814	506
c Poor Site Productivity (ha) (15)			731	102
Total			**8254**	**670**
ASSEEK ESTUARY	2	North		
a Early (ha) AC = 0,1,2			18	
a Mature (ha) AC = 5-8			0	
a Mid (ha) AC = 3,4			4	
a Old (ha) AC = 9			0	
Total			**22**	
b Early Volume (m3)			11	3
b Mature Volume (m3)			89	89
b Mid Volume (m3)			1223	167
b Old Volume (m3)			5	5
Total			**1328**	**264**
c Good Site Productivity (ha) (>25)			0	
c Low Site Productivity (ha) (0,5,10)			18	
c Medium Site Productivity (ha) (20-25)			4	1
c Poor Site Productivity (ha) (15)			0	
Total			**22**	**1**
BARNARD HARBOUR	2	North		
a Early (ha) AC = 0,1,2			100	
a Mature (ha) AC = 5-8			23	
a Old (ha) AC = 9			837	7
Total			**960**	**7**
b Mature Volume (m3)			5795	
b Old Volume (m3)			168838	3794
Total			**174633**	**3794**
c Low Site Productivity (ha) (0,5,10)			928	
c Poor Site Productivity (ha) (15)			32	7
Total			**960**	**7**
BELLA COOLA ESTUARY	2	North		
a Early (ha) AC = 0,1,2			108	
a Mature (ha) AC = 5-8			20	
a Old (ha) AC = 9			0	
Total			**128**	
b Mature Volume (m3)			990	
b Old Volume (m3)			96	
Total			**1086**	
c Good Site Productivity (ha) (>25)			6	
c Low Site Productivity (ha) (0,5,10)			80	

c Medium Site Productivity (ha) (20-25)			28	
c Poor Site Productivity (ha) (15)			14	
Total			**118**	
CANN INLET	2	North		
a Early (ha) AC = 0,1,2			33	
a Mature (ha) AC = 5-8			227	
a Old (ha) AC = 9			134	
c Low Site Productivity (ha) (0,5,10)			394	
Total			**788**	
CARTER BAY	2	North		
a Early (ha) AC = 0,1,2			14	
a Old (ha) AC = 9			240	157
Total			**254**	**157**
b Old Volume (m3)			109253	67272
Total			**109253**	**67272**
c Low Site Productivity (ha) (0,5,10)			14	
c Poor Site Productivity (ha) (15)			240	157
Total			**254**	**157**
CLAYTON FALLS	2	North		
a Early (ha) AC = 0,1,2			811	26
a Mature (ha) AC = 5-8			883	69
a Mid (ha) AC = 3,4			14	
a Old (ha) AC = 9			318	51
Total			**2026**	**146**
b Mature Volume (m3)			242893	27826
b Old Volume (m3)			149208	30447
Total			**392101**	**58273**
c Low Site Productivity (ha) (0,5,10)			1652	
c Medium Site Productivity (ha) (20-25)			28	26
c Poor Site Productivity (ha) (15)			345	120
Total			**2026**	**146**
CLYAK ESTUARY	2	North		
a Early (ha) AC = 0,1,2			72	3
a Mature (ha) AC = 5-8			5	5
a Mid (ha) AC = 3,4			53	17
a Old (ha) AC = 9			126	94
Total			**256**	**119**
b Early Volume (m3)			80	80
b Mature Volume (m3)			4331	4014
b Mid Volume (m3)			20516	10031
b Old Volume (m3)			84593	72227
Total			**109520**	**86352**
c Good Site Productivity (ha) (>25)			81	51
c Low Site Productivity (ha) (0,5,10)			84	
c Medium Site Productivity (ha) (20-25)			47	39
c Poor Site Productivity (ha) (15)			43	28
Total			**256**	**118**
CODVILLE	2	North		
a Early (ha) AC = 0,1,2			22	
a Mature (ha) AC = 5-8			199	
a Old (ha) AC = 9			857	
Total			**1078**	**0**
b Mature Volume (m3)			46344	
b Old Volume (m3)			285637	

Total			**331981**	**0**
c Low Site Productivity (ha) (0,5,10)			828	
c Medium Site Productivity (ha) (20-25)			46	
c Poor Site Productivity (ha) (15)			203	
Total			**1078**	**0**
CORNWALL ESTUARY	2	North		
a Early (ha) AC = 0,1,2			2	
a Mature (ha) AC = 5-8			2	2
a Mid (ha) AC = 3,4			1	
a Old (ha) AC = 9			15	13
Total			**19**	**15**
b Mature Volume (m3)			903	898
b Mid Volume (m3)			189	
b Old Volume (m3)			6299	5920
Total			**7391**	**6818**
c Low Site Productivity (ha) (0,5,10)			4	
c Medium Site Productivity (ha) (20-25)			2	2
c Poor Site Productivity (ha) (15)			14	13
Total			**19**	**15**
CRANSTOWN POINT	2	North		
a Early (ha) AC = 0,1,2			19	
a Mature (ha) AC = 5-8			3	
a Old (ha) AC = 9			96	
Total			**117**	**0**
b Old Volume (m3)			32747	
Total			**32747**	
c Low Site Productivity (ha) (0,5,10)			92	
c Poor Site Productivity (ha) (15)			25	
Total			**117**	**0**
DEAN CORRIDOR	1	North		
a Early (ha) AC = 0,1,2			1383	918
a Mature (ha) AC = 5-8			2348	1114
a Mid (ha) AC = 3,4			8	
a Old (ha) AC = 9			324	212
Total			**4063**	**2244**
b Early Volume (m3)			33015	17442
b Mature Volume (m3)			1100843	531628
b Mid Volume (m3)			1715	
b Old Volume (m3)			161543	116267
Total			**1297116**	**665337**
c Good Site Productivity (ha) (>25)			200	101
c Low Site Productivity (ha) (0,5,10)			323	
c Medium Site Productivity (ha) (20-25)			2848	1741
c Poor Site Productivity (ha) (15)			692	402
Total			**4063**	**2244**
ELLERSLIE LAKE HARBOURS	1	North		
a Early (ha) AC = 0,1,2			4489	112
a Mature (ha) AC = 5-8			4589	488
a Mid (ha) AC = 3,4			10	1
a Old (ha) AC = 9			4507	1196
Total			**13595**	**1797**
b Early Volume (m3)			7551	4916
b Mature Volume (m3)			1334921	267870
b Mid Volume (m3)			2661	285

b Old Volume (m3)			1560556	715328
Total			**2905689**	**988399**
c Good Site Productivity (ha) (>25)			108	99
c Low Site Productivity (ha) (0.5.10)			9480	
c Medium Site Productivity (ha) (20-25)			291	211
c Poor Site Productivity (ha) (15)			3717	1487
Total			**13595**	**1797**
EMILY CARR INLET	2	North		
a Early (ha) AC = 0,1,2			38	36
a Mature (ha) AC = 5-8			128	128
a Mid (ha) AC = 3,4			0	
a Old (ha) AC = 9			609	166
Total			**775**	**330**
b Early Volume (m3)			2347	2347
b Mature Volume (m3)			82983	82983
b Mid Volume (m3)			76	76
b Old Volume (m3)			223226	90260
Total			**308632**	**175666**
c Low Site Productivity (ha) (0.5.10)			444	
c Medium Site Productivity (ha) (20-25)			37	36
c Poor Site Productivity (ha) (15)			294	294
Total			**775**	**330**
EUCOTT BAY	2	North		
a Early (ha) AC = 0,1,2			37	
a Mature (ha) AC = 5-8			80	6
a Mid (ha) AC = 3,4			6	
a Old (ha) AC = 9			17	
Total			**140**	**6**
b Mature Volume (m3)			21502	1876
b Mid Volume (m3)			309	
b Old Volume (m3)			10410	
Total			**32221**	**1876**
c Low Site Productivity (ha) (0.5.10)			66	
c Medium Site Productivity (ha) (20-25)			14	3
c Poor Site Productivity (ha) (15)			60	3
Total			**140**	**6**
FOUGNAR BAY	2	North		
a Early (ha) AC = 0,1,2			232	
a Old (ha) AC = 9			182	165
Total			**414**	**165**
b Old Volume (m3)			97003	88659
Total			**97003**	**88659**
c Low Site Productivity (ha) (0.5.10)			232	
c Medium Site Productivity (ha) (20-25)			66	66
c Poor Site Productivity (ha) (15)			116	99
Total			**414**	**165**
GENESSE WETLAND	2	North	22	7
a Early (ha) AC = 0,1,2			80	65
a Mature (ha) AC = 5-8			1	1
a Old (ha) AC = 9			1472	351
Total			**1553**	**417**
b Early Volume (m3)			54440	48391
b Mature Volume (m3)			1196	1019
b Old Volume (m3)			76	57
Total			**55712**	**49467**
c Good Site Productivity (ha) (>25)			9	

c Low Site Productivity (ha) (0,5,10)			2	1
c Medium Site Productivity (ha) (20-25)			16	15
c Poor Site Productivity (ha) (15)				
Total			**26**	**16**
GOAT COVE	2	North		
a Early (ha) AC = 0,1,2			18	
a Mid (ha) AC = 3,4			3	
a Old (ha) AC = 9			200	64
Total			**222**	**64**
b Mid Volume (m3)			807	
b Old Volume (m3)			107849	47694
Total			**108656**	**47694**
c Low Site Productivity (ha) (0,5,10)			104	
c Medium Site Productivity (ha) (20-25)			55	29
c Poor Site Productivity (ha) (15)			63	35
Total			**222**	**64**
GRANT ANCHORAGE	2	North		
a Early (ha) AC = 0,1,2			69	
a Mature (ha) AC = 5-8			682	
a Old (ha) AC = 9			45	
Total			**795**	**0**
b Mature Volume (m3)			77252	
b Old Volume (m3)			28994	
Total			**106246**	**0**
c Low Site Productivity (ha) (0,5,10)			750	
c Medium Site Productivity (ha) (20-25)			45	
Total			**795**	**0**
HOTSPRINGS	1	North		
a Early (ha) AC = 0,1,2			7649	0
a Mature (ha) AC = 5-8			1339	250
a Mid (ha) AC = 3,4			68	19
a Old (ha) AC = 9			740	175
Total			**9796**	**444**
b Mature Volume (m3)			333997	138859
b Mid Volume (m3)			5068	1291
b Old Volume (m3)			371372	118768
Total			**710437**	**258918**
c Low Site Productivity (ha) (0,5,10)			9027	0
c Medium Site Productivity (ha) (20-25)			124	68
c Poor Site Productivity (ha) (15)			644	376
Total			**9795**	**444**
ICKNA ESTUARY	2	North		
a Early (ha) AC = 0,1,2			65	
Total			**65**	**0**
b Early Volume (m3)			7264	9
Total			**7264**	**9**
c Good Site Productivity (ha) (>25)			18	
c Low Site Productivity (ha) (0,5,10)			40	
c Medium Site Productivity (ha) (20-25)			7	
Total			**65**	**0**
KHUTZE	1	North		
a Early (ha) AC = 0,1,2			26713	100
a Mature (ha) AC = 5-8			1828	162
a Mid (ha) AC = 3,4			220	14

a Old (ha) AC = 9			4475	1256
Total			**33236**	**1532**
b Mature Volume (m3)			721512	92781
b Old Volume (m3)			2580957	810212
Total			**3302469**	**902993**
c Good Site Productivity (ha) (>25)			481	280
c Low Site Productivity (ha) (0,5,10)			27128	
c Medium Site Productivity (ha) (20-25)			3533	1061
c Poor Site Productivity (ha) (15)			2094	191
Total			**33236**	**1532**
KILBELLA ESTUARY	2	North		
a Early (ha) AC = 0,1,2			161	
a Mature (ha) AC = 5-8			32	
a Mid (ha) AC = 3,4			11	
a Old (ha) AC = 9			16	1
Total			**220**	**1**
b Mature Volume (m3)			17335	214
b Mid Volume (m3)			6609	
b Old Volume (m3)			11341	634
Total			**35285**	**848**
c Good Site Productivity (ha) (>25)			27	
c Low Site Productivity (ha) (0,5,10)			171	
c Medium Site Productivity (ha) (20-25)			14	1
c Poor Site Productivity (ha) (15)			8	
Total			**220**	**1**
KIMSQUIT ESTUARY	2	North		
a Early (ha) AC = 0,1,2			21	
a Mature (ha) AC = 5-8			32	4
a Mid (ha) AC = 3,4			3	3
a Old (ha) AC = 9			1	1
Total			**57**	**8**
b Mature Volume (m3)			5010	748
b Mid Volume (m3)			1777	1775
b Old Volume (m3)			514	514
Total			**7301**	**3037**
c Good Site Productivity (ha) (>25)			3	3
c Low Site Productivity (ha) (0,5,10)			21	
c Medium Site Productivity (ha) (20-25)			30	2
c Poor Site Productivity (ha) (15)			3	3
Total			**57**	**8**
KOEYE	1	North		
a Early (ha) AC = 0,1,2			7789	76
a Mature (ha) AC = 5-8			415	373
a Old (ha) AC = 9			9400	8276
Total			**17604**	**8725**
b Mature Volume (m3)			256639	248790
b Old Volume (m3)			6048098	5451489
Total			**6304737**	**5700279**
c Good Site Productivity (ha) (>25)			189	189
c Low Site Productivity (ha) (0,5,10)			7918	1
c Medium Site Productivity (ha) (20-25)			7735	6981
c Poor Site Productivity (ha) (15)			1762	1555
Total			**17604**	**8726**
KWATNA ESTUARY	2	North		
a Early (ha) AC = 0,1,2			114	
a Mature (ha) AC = 5-8			37	16

a Mid (ha) AC = 3,4			23	1
Total			**174**	**17**
b Mature Volume (m3)			18245	11738
b Mid Volume (m3)			11824	441
Total			**30069**	**12179**
c Good Site Productivity (ha) (>25)			3	
c Low Site Productivity (ha) (0,5,10)			126	
c Medium Site Productivity (ha) (20-25)			36	15
c Poor Site Productivity (ha) (15)			9	2
Total			**174**	**17**
MCMULLEN GROUP	2	North		
a Early (ha) AC = 0,1,2			24	
a Old (ha) AC = 9			15	
Total			**39**	**0**
b Old Volume (m3)			4550	
Total			**4550**	**0**
c Low Site Productivity (ha) (0,5,10)			39	
Total			**39**	**0**
NEECHANTZ/MACHMELL WETLAND	2	North		
a Early (ha) AC = 0,1,2			11	5
a Mature (ha) AC = 5-8			66	5
a Old (ha) AC = 9			78	28
Total			**155**	**38**
b Early Volume (m3)			247	218
b Mature Volume (m3)			21967	3910
b Old Volume (m3)			65756	23226
Total			**87970**	**27354**
c Good Site Productivity (ha) (>25)			25	10
c Low Site Productivity (ha) (0,5,10)			6	
c Medium Site Productivity (ha) (20-25)			91	28
c Poor Site Productivity (ha) (15)			33	
Total			**155**	**38**
OLIVER COVE	2	North		
a Early (ha) AC = 0,1,2			194	5
a Mid (ha) AC = 3,4			20	
a Old (ha) AC = 9			3164	1
Total			**3379**	**6**
b Mid Volume (m3)			7150	
b Old Volume (m3)			167265	521
Total			**174415**	**521**
c Low Site Productivity (ha) (0,5,10)			3228	
c Medium Site Productivity (ha) (20-25)			26	
c Poor Site Productivity (ha) (15)			124	5
Total			**3379**	**5**
PORT JOHN ARCHAEOLOGICAL SITE	2	North		
a Early (ha) AC = 0,1,2			1	
a Mature (ha) AC = 5-8			16	
a Old (ha) AC = 9			11	
Total			**28**	**0**
b Old Volume (m3)			4287	
Total			**4287**	**0**
c Low Site Productivity (ha) (0,5,10)			19	
c Poor Site Productivity (ha) (15)			9	

Total			**28**	**0**
QUATLENA ESTUARY	2	North		
a Early (ha) AC = 0,1,2			27	20
a Mature (ha) AC = 5-8			3	
a Mid (ha) AC = 3,4			4	4
a Old (ha) AC = 9			10	5
Total			**43**	**29**
b Early Volume (m3)			845	844
b Mature Volume (m3)			1118	
b Mid Volume (m3)			1279	1279
b Old Volume (m3)			5862	3129
Total			**9104**	**5252**
c Low Site Productivity (ha) (0,5,10)			7	
c Medium Site Productivity (ha) (20-25)			31	27
c Poor Site Productivity (ha) (15)			5	2
Total			**43**	**29**
RACEY INLET	2	North		
a Mature (ha) AC = 5-8			10	
a Old (ha) AC = 9			243	
Total			**254**	**0**
b Mature Volume (m3)			3675	
b Old Volume (m3)			1766	
Total			**5441**	**0**
c Low Site Productivity (ha) (0,5,10)			254	
Total			**254**	**0**
REEVE	1	North		
a Early (ha) AC = 0,1,2			3932	
a Mature (ha) AC = 5-8			1022	180
a Mid (ha) AC = 3,4			28	
a Old (ha) AC = 9			1160	1
Total			**6143**	**181**
b Mature Volume (m3)			313814	97422
b Mid Volume (m3)			2275	
b Old Volume (m3)			525704	452
Total			**841793**	**97874**
c Good Site Productivity (ha) (>25)			93	23
c Low Site Productivity (ha) (0,5,10)			4829	
c Medium Site Productivity (ha) (20-25)			485	135
c Poor Site Productivity (ha) (15)			735	23
Total			**6143**	**181**
RESCUE BAY	2	North		
a Early (ha) AC = 0,1,2			65	
a Mid (ha) AC = 3,4			1	
a Old (ha) AC = 9			175	10
Total			**241**	**10**
b Mid Volume (m3)			224	
b Old Volume (m3)			71199	6734
Total			**71423**	**6734**
c Low Site Productivity (ha) (0,5,10)			186	
c Medium Site Productivity (ha) (20-25)			17	1
c Poor Site Productivity (ha) (15)			38	9
Total			**241**	**10**
RESTORATION BAY	2	North		
a Early (ha) AC = 0,1,2			67	41

a Mature (ha) AC = 5-8			193	
a Mid (ha) AC = 3,4			31	
a Old (ha) AC = 9			423	6
Total			**714**	**47**
b Early Volume (m3)			2038	2034
b Mature Volume (m3)			62613	167
b Mid Volume (m3)			7744	
b Old Volume (m3)			172816	2482
Total			**245211**	**4683**
c Low Site Productivity (ha) (0,5,10)			267	
c Medium Site Productivity (ha) (20-25)			183	41
c Poor Site Productivity (ha) (15)			265	7
Total			**714**	**48**
SHEEMAHANT WETLAND	2	North		
a Early (ha) AC = 0,1,2			60	14
a Mature (ha) AC = 5-8			64	54
a Mid (ha) AC = 3,4			11	2
a Old (ha) AC = 9			4	1
Total			**139**	**71**
b Early Volume (m3)			527	527
b Mature Volume (m3)			34938	33117
b Mid Volume (m3)			1084	603
b Old Volume (m3)			2422	354
Total			**38971**	**34601**
c Good Site Productivity (ha) (>25)			23	17
c Low Site Productivity (ha) (0,5,10)			45	
c Medium Site Productivity (ha) (20-25)			53	48
c Poor Site Productivity (ha) (15)			19	5
Total			**139**	**70**
SKOWQUILTZ ESTUARY	2	North		
a Early (ha) AC = 0,1,2			25	
a Mature (ha) AC = 5-8			1	
a Old (ha) AC = 9			1	
Total			**27**	**0**
b Mature Volume (m3)			144	
b Old Volume (m3)			687	
Total			**831**	**0**
c Low Site Productivity (ha) (0,5,10)			25	
c Medium Site Productivity (ha) (20-25)			1	
c Poor Site Productivity (ha) (15)			1	
Total			**27**	**0**
SMITHERS ISLAND	2	North		
a Old (ha) AC = 9			0	
c Low Site Productivity (ha) (0,5,10)			0	
Total			**1**	**0**
SPIRIT BEAR	1	North		
a Early (ha) AC = 0,1,2			24471	16
a Mature (ha) AC = 5-8			4937	561
a Mid (ha) AC = 3,4			191	47
a Old (ha) AC = 9			46301	10680
Total			**75900**	**11304**
b Mature Volume (m3)			771740	306920
b Mid Volume (m3)			183	
b Old Volume (m3)			17872498	6938460
Total			**18644421**	**7245380**

c Good Site Productivity (ha) (>25)			1994	1061
c Low Site Productivity (ha) (0,5,10)			48898	1
c Medium Site Productivity (ha) (20-25)			15838	7292
c Poor Site Productivity (ha) (15)			9170	2950
Total			**75900**	**11304**
SWANSON BAY	2	North		
a Early (ha) AC = 0,1,2			5	
a Mature (ha) AC = 5-8			0	
a Mid (ha) AC = 3,4			12	
a Old (ha) AC = 9			26	19
Total			**43**	**19**
b Mature Volume (m3)			117	117
b Old Volume (m3)			15516	11164
Total			**15633**	**11281**
c Low Site Productivity (ha) (0,5,10)			5	
c Medium Site Productivity (ha) (20-25)			36	18
c Poor Site Productivity (ha) (15)			1	1
Total			**43**	**19**
TALEOMEY/NOEICK ESTUARIES	2	North		
a Early (ha) AC = 0,1,2			128	2
a Mature (ha) AC = 5-8			1	
a Mid (ha) AC = 3,4			29	16
Total			**158**	**18**
b Early Volume (m3)			183	111
b Mature Volume (m3)			202	1
b Mid Volume (m3)			7179	4517
Total			**7564**	**4629**
c Good Site Productivity (ha) (>25)			14	7
c Low Site Productivity (ha) (0,5,10)			125	
c Medium Site Productivity (ha) (20-25)			18	11
c Poor Site Productivity (ha) (15)			1	
Total			**158**	**18**
THORSEN CREEK	2	North		
a Early (ha) AC = 0,1,2			6	6
a Mature (ha) AC = 5-8			3	3
Total			**9**	**9**
b Early Volume (m3)			300	293
b Mature Volume (m3)			1295	1295
Total			**1595**	**1588**
c Good Site Productivity (ha) (>25)			0	
c Medium Site Productivity (ha) (20-25)			6	6
c Poor Site Productivity (ha) (15)			3	3
Total			**9**	**9**
TROUP PASSAGE	2	North		
a Early (ha) AC = 0,1,2			128	
a Mature (ha) AC = 5-8			925	44
a Old (ha) AC = 9			1682	47
Total			**2734**	**91**
b Mature Volume (m3)			220394	24102
b Old Volume (m3)			465914	22318
Total			**686308**	**46420**
c Low Site Productivity (ha) (0,5,10)			2171	
c Medium Site Productivity (ha) (20-25)			70	
c Poor Site Productivity (ha) (15)			493	92
Total			**2734**	**92**

UPPER INZIANA	1	North		
a Early (ha) AC = 0,1,2			2087	
a Mature (ha) AC = 5-8			3	
a Mid (ha) AC = 3,4			10	
a Old (ha) AC = 9			297	
Total			**2387**	
b Mid Volume (m3)			492	
b Old Volume (m3)			84811	
Total			**85303**	
c Low Site Productivity (ha) (0,5,10)			2329	
c Medium Site Productivity (ha) (20-25)			7	
c Poor Site Productivity (ha) (15)			60	
Total			**2396**	
UPPER KIMSQUIT	1	North		
a Early (ha) AC = 0,1,2			8135	
a Mature (ha) AC = 5-8			1267	
a Mid (ha) AC = 3,4			75	
a Old (ha) AC = 9			963	
Total			**10440**	
b Early Volume (m3)			1089	
b Mature Volume (m3)			327448	
b Mid Volume (m3)			4165	
b Old Volume (m3)			636214	
Total			**968916**	
c Low Site Productivity (ha) (0,5,10)			9329	
c Medium Site Productivity (ha) (20-25)			261	
c Poor Site Productivity (ha) (15)			850	
Total			**10440**	
WALKUS LAKE	2	North		
a Early (ha) AC = 0,1,2			6	
a Mature (ha) AC = 5-8			112	21
a Old (ha) AC = 9			668	384
Total			**786**	**405**
b Mature Volume (m3)			38031	13650
b Old Volume (m3)			451544	292646
Total			**489575**	**306296**
c Good Site Productivity (ha) (>25)			98	96
c Low Site Productivity (ha) (0,5,10)			255	
c Medium Site Productivity (ha) (20-25)			104	93
c Poor Site Productivity (ha) (15)			328	216
Total			**786**	**405**
AHNUHATI COMPLEX	1	South		
a Early (ha) AC = 0,1,2			36888	395
a Mature (ha) AC = 5-8			6074	1358
a Mid (ha) AC = 3,4			1418	389
a Old (ha) AC = 9			7195	1591
Total			**50305**	**3733**
b Early Volume (m3)			4736	4429
b Mature Volume (m3)			3199913	904162
b Mid Volume (m3)			127133	41149
b Old Volume (m3)			3233264	1113978
Total			**6565046**	**2063718**
c Good Site Productivity (ha) (>25)			1047	510

c Low Site Productivity (ha) (0.5.10)			41717	
c Medium Site Productivity (ha) (20-25)			3675	1622
c Poor Site Productivity (ha) (15)			5136	1602
Total			**51574**	**3734**
	2	South		
BARRY ISLET				
a Early (ha) AC = 0,1,2			17	
a Mature (ha) AC = 5-8			3	
a Old (ha) AC = 9			26	
Total			**46**	
b Mature Volume (m3)			809	
b Old Volume (m3)			1382	
Total			**2191**	
c Low Site Productivity (ha) (0.5.10)			43	
c Poor Site Productivity (ha) (15)			3	
Total			**46**	
	2	South		
BOAT BAY				
a Early (ha) AC = 0,1,2			137	24
a Mature (ha) AC = 5-8			99	76
a Mid (ha) AC = 3,4			268	199
a Old (ha) AC = 9			107	42
Total			**611**	**341**
b Early Volume (m3)			1937	611
b Mature Volume (m3)			49498	46170
b Mid Volume (m3)			138591	101831
b Old Volume (m3)			48968	25896
Total			**238994**	**174508**
c Good Site Productivity (ha) (>25)			195	129
c Low Site Productivity (ha) (0.5.10)			188	
c Medium Site Productivity (ha) (20-25)			169	160
c Poor Site Productivity (ha) (15)			58	54
Total			**611**	**343**
	1	South		
BROUGHTON EXTENSION				
a Early (ha) AC = 0,1,2			384	180
a Mature (ha) AC = 5-8			244	180
a Mid (ha) AC = 3,4			844	657
a Old (ha) AC = 9			1836	1108
Total			**3307**	**2125**
b Early Volume (m3)			2211	2211
b Mature Volume (m3)			148494	116838
b Mid Volume (m3)			179405	168132
b Old Volume (m3)			1017201	702924
Total			**1347311**	**990105**
c Good Site Productivity (ha) (>25)			191	183
c Low Site Productivity (ha) (0.5.10)			788	
c Medium Site Productivity (ha) (20-25)			599	588
c Poor Site Productivity (ha) (15)			1729	1355
Total			**3307**	**2126**
	2	South		
BURDWOOD GROUP				
a Early (ha) AC = 0,1,2			28	
a Mature (ha) AC = 5-8			42	
a Old (ha) AC = 9			55	
Total			**124**	**0**
b Mature Volume (m3)			21302	
b Old Volume (m3)			33667	

Total			**54969**	**0**
c Low Site Productivity (ha) (0,5,10)			41	
c Medium Site Productivity (ha) (20-25)			29	
c Poor Site Productivity (ha) (15)			55	
Total			**124**	**0**
CAPE CAUTION	1	South		
a Early (ha) AC = 0,1,2			863	
a Mature (ha) AC = 5-8			1011	
a Mid (ha) AC = 3,4			20	13
a Old (ha) AC = 9			8232	209
Total			**10127**	**222**
b Mature Volume (m3)			136073	9
b Mid Volume (m3)			2660	2018
b Old Volume (m3)			1500949	104479
Total			**1639682**	**106506**
c Low Site Productivity (ha) (0,5,10)			9606	
c Medium Site Productivity (ha) (20-25)			21	13
c Poor Site Productivity (ha) (15)			500	209
Total			**10127**	**222**
CULLEN HARBOUR	2	South		
a Early (ha) AC = 0,1,2			20	
a Mature (ha) AC = 5-8			31	6
a Mid (ha) AC = 3,4			45	36
a Old (ha) AC = 9			128	25
Total			**224**	**67**
b Mature Volume (m3)			16849	3281
b Mid Volume (m3)			23738	23281
b Old Volume (m3)			69242	15120
Total			**109829**	**41682**
c Good Site Productivity (ha) (>25)			17	17
c Low Site Productivity (ha) (0,5,10)			36	
c Medium Site Productivity (ha) (20-25)			20	20
c Poor Site Productivity (ha) (15)			150	30
Total			**224**	**67**
DESERTERS AND WALKER GROUP	1	South		
a Early (ha) AC = 0,1,2			175	
a Mature (ha) AC = 5-8			16	
a Old (ha) AC = 9			613	
Total			**804**	
b Mature Volume (m3)			6376	
b Old Volume (m3)			6078	
Total			**12454**	
c Low Site Productivity (ha) (0,5,10)			788	
c Poor Site Productivity (ha) (15)			16	
Total			**804**	
DUKE OF EDINBURGH EXTENSION	1	South		
a Early (ha) AC = 0,1,2			8	
Total			**8**	
c Low Site Productivity (ha) (0,5,10)			8	
Total			**8**	
FORWARD HARBOUR	2	South		

a Early (ha) AC = 0,1,2			104	73
a Mature (ha) AC = 5-8			115	86
a Mid (ha) AC = 3,4			87	53
a Old (ha) AC = 9			103	56
Total			**409**	**268**
b Early Volume (m3)			1356	1356
b Mature Volume (m3)			83480	65277
b Mid Volume (m3)			49129	29501
b Old Volume (m3)			61672	44579
Total			**195637**	**140713**
c Good Site Productivity (ha) (>25)			159	113
c Low Site Productivity (ha) (0,5,10)			71	
c Medium Site Productivity (ha) (20-25)			150	135
c Poor Site Productivity (ha) (15)			28	21
Total			**409**	**269**
KINGCOME ESTUARY	2	South		
a Early (ha) AC = 0,1,2			59	
a Mature (ha) AC = 5-8			1	1
a Mid (ha) AC = 3,4			0	
Total			**60**	**1**
b Mature Volume (m3)			494	494
b Mid Volume (m3)			94	
Total			**588**	**494**
c Good Site Productivity (ha) (>25)			0	
c Low Site Productivity (ha) (0,5,10)			59	
c Medium Site Productivity (ha) (20-25)			1	1
Total			**60**	**1**
KLINAKLINI ESTUARY	2	South		
a Early (ha) AC = 0,1,2			290	
a Mature (ha) AC = 5-8			5	1
a Mid (ha) AC = 3,4			61	50
Total			**355**	**51**
c Good Site Productivity (ha) (>25)			61	50
c Low Site Productivity (ha) (0,5,10)			290	
c Medium Site Productivity (ha) (20-25)			5	1
c Poor Site Productivity (ha) (15)			0	
Total			**355**	**51**
NEKITE ESTUARY	2	South		
a Early (ha) AC = 0,1,2			74	5
a Mature (ha) AC = 5-8			5	5
a Mid (ha) AC = 3,4			8	1
a Old (ha) AC = 9			44	21
Total			**131**	**32**
b Early Volume (m3)			569	434
b Mature Volume (m3)			1834	1834
b Mid Volume (m3)			2004	117
b Old Volume (m3)			22465	13418
Total			**26872**	**15803**
c Good Site Productivity (ha) (>25)			3	
c Low Site Productivity (ha) (0,5,10)			80	
c Medium Site Productivity (ha) (20-25)			28	23
c Poor Site Productivity (ha) (15)			21	9
Total			**131**	**32**
NUMAS ISLANDS	2	South		
a Early (ha) AC = 0,1,2			179	
Total			**179**	**0**

c Low Site Productivity (ha) (0,5,10)			179	
Total			**179**	**0**
PHILLIPS ESTUARY/LAKE	2	South		
a Early (ha) AC = 0,1,2			531	198
a Mature (ha) AC = 5-8			79	63
a Mid (ha) AC = 3,4			319	121
a Old (ha) AC = 9			279	154
Total			**1208**	**536**
b Early Volume (m3)			18809	10423
b Mature Volume (m3)			9019	6193
b Mid Volume (m3)			115838	35949
b Old Volume (m3)			234808	129314
Total			**378474**	**181879**
c Good Site Productivity (ha) (>25)			253	139
c Low Site Productivity (ha) (0,5,10)			241	
c Medium Site Productivity (ha) (20-25)			575	317
c Poor Site Productivity (ha) (15)			139	81
Total			**1208**	**537**
POLKINGHORN	2	South		
a Early (ha) AC = 0,1,2			25	
a Old (ha) AC = 9			123	
Total			**149**	**0**
b Old Volume (m3)			34005	
Total			**34005**	**0**
c Low Site Productivity (ha) (0,5,10)			149	
Total			**149**	**0**
SEYMOUR ESTUARY	2	South		
a Early (ha) AC = 0,1,2			31	2
a Mature (ha) AC = 5-8			4	2
a Mid (ha) AC = 3,4			117	19
a Old (ha) AC = 9			88	62
Total			**240**	**85**
b Mature Volume (m3)			3056	1701
b Mid Volume (m3)			23687	8664
b Old Volume (m3)			57572	45276
Total			**84315**	**55641**
c Good Site Productivity (ha) (>25)			0	
c Low Site Productivity (ha) (0,5,10)			44	
c Medium Site Productivity (ha) (20-25)			185	74
c Poor Site Productivity (ha) (15)			11	11
Total			**240**	**85**
SMOKEHOUSE	1	South		
a Early (ha) AC = 0,1,2			15711	442
a Mature (ha) AC = 5-8			2152	242
a Mid (ha) AC = 3,4			238	49
a Old (ha) AC = 9			17821	1932
Total			**35922**	**2665**
b Early Volume (m3)			32155	20679
b Mature Volume (m3)			503593	170861
b Mid Volume (m3)			27687	16960
b Old Volume (m3)			5631007	1383242
Total			**6194442**	**1591742**
c Good Site Productivity (ha) (>25)			43	34
c Low Site Productivity (ha) (0,5,10)			28617	
c Medium Site Productivity (ha) (20-25)			1922	1146
c Poor Site Productivity (ha) (15)			5340	1484

Total			**35922**	**2664**
STAFFORD ESTUARY	2	South		
a Early (ha) AC = 0,1,2			185	1
a Mature (ha) AC = 5-8			128	54
a Mid (ha) AC = 3,4			182	122
Total			**495**	**177**
b Early Volume (m3)			1372	79
b Mature Volume (m3)			85765	42114
b Mid Volume (m3)			66992	47149
Total			**154129**	**89342**
c Good Site Productivity (ha) (>25)			115	65
c Low Site Productivity (ha) (0,5,10)			177	
c Medium Site Productivity (ha) (20-25)			182	106
c Poor Site Productivity (ha) (15)			21	6
Total			**495**	**177**
TAKUSH HARBOUR	2	South		
a Early (ha) AC = 0,1,2			298	174
a Mature (ha) AC = 5-8			165	21
a Mid (ha) AC = 3,4			13	6
a Old (ha) AC = 9			1279	487
Total			**1755**	**688**
b Early Volume (m3)			9141	4402
b Mature Volume (m3)			64600	9132
b Mid Volume (m3)			1504	832
b Old Volume (m3)			559821	290409
Total			**635066**	**304775**
c Low Site Productivity (ha) (0,5,10)			859	
c Medium Site Productivity (ha) (20-25)			234	185
c Poor Site Productivity (ha) (15)			663	503
Total			**1755**	**688**
THURSTON BAY	2	South		
a Early (ha) AC = 0,1,2			65	16
a Mature (ha) AC = 5-8			86	26
a Mid (ha) AC = 3,4			36	4
a Old (ha) AC = 9			15	10
Total			**202**	**56**
b Early Volume (m3)			979	979
b Mature Volume (m3)			58357	17991
b Mid Volume (m3)			16990	1887
b Old Volume (m3)			8358	7942
Total			**84684**	**28799**
c Good Site Productivity (ha) (>25)			81	23
c Low Site Productivity (ha) (0,5,10)			53	
c Medium Site Productivity (ha) (20-25)			63	29
c Poor Site Productivity (ha) (15)			5	5
Total			**202**	**57**
WAKEMAN ESTUARY	2	South		
a Early (ha) AC = 0,1,2			89	
a Mature (ha) AC = 5-8			42	15
a Mid (ha) AC = 3,4			18	
a Old (ha) AC = 9			1	1
Total			**149**	**16**
b Mature Volume (m3)			23531	11210
b Mid Volume (m3)			4410	2
b Old Volume (m3)			550	542
Total			**28491**	**11754**

c Good Site Productivity (ha) (>25)			15	15
c Low Site Productivity (ha) (0,5,10)			116	
c Medium Site Productivity (ha) (20-25)			18	
c Poor Site Productivity (ha) (15)			1	1
Total			**149**	**16**
YORKE ISLAND	2	South		
a Early (ha) AC = 0,1,2			6	
a Mature (ha) AC = 5-8			8	
a Mid (ha) AC = 3,4			25	
Total			**38**	**0**
b Mature Volume (m3)			3839	
b Mid Volume (m3)			8724	
Total			**12563**	**0**
c Low Site Productivity (ha) (0,5,10)			6	
c Medium Site Productivity (ha) (20-25)			31	
c Poor Site Productivity (ha) (15)			1	
Total			**38**	**0**

APPENDIX E: THLB Age Class Data By Landscape Unit

CCLCRMP Forum	**Landscape Unit**	**Landscape Unit LAND Area (ha)**	**THLB Total Area (ha)** *AC = 1-9*	**Early Seral Stage THLB (ha)** *AC = 1&2*	**Mid Seral Stage THLB (ha)** *AC = 3&4*	**Mature Seral Stage THLB (ha)** *AC = 5-8*	**Old Seral Stage THLB (ha)** *AC = 9*
CCoast North	Aaltanhash	18254	2578	152	17	358	2051
CCoast North	Ape	59629	240	0	0	46	194
CCoast North	Atnarko	68585	0	0	0	0	0
CCoast North	Bella Coola	23406	3064	1942	268	458	396
CCoast North	Bishop	2	0	0	0	0	0
CCoast North	Braden	58199	3220	515	49	489	2167
CCoast North	Butedale	21502	3291	97	24	308	2862
CCoast North	Calvert	36550	0	0	0	0	0
CCoast North	Chapple	21108	943	173	23	153	594
CCoast North	Clayton	27944	5563	1231	268	2430	1634
CCoast North	Clyak	45134	7380	2620	192	210	4358
CCoast North	Crag	88290	573	77	0	394	102
CCoast North	Dean	79727	5281	1426	0	2628	1227
CCoast North	Denny	27742	919	0	0	340	579
CCoast North	Don Peninsula	41229	4696	107	0	640	3949
CCoast North	Doos/Dallery	46735	5548	1284	186	733	3345
CCoast North	Draney	18291	3029	1092	48	107	1782
CCoast North	Ellerslie	28397	4433	102	1	1459	2871
CCoast North	Evans	40566	1149	0	22	213	914
CCoast North	Fish Egg	38179	2095	167	55	196	1677
CCoast North	Green	32373	4757	13	16	292	4436
CCoast North	Helmcken	35837	96	0	0	0	96
CCoast North	Hunter	43764	114	114	0	0	0
CCoast North	Johnston	28027	2798	0	10	434	2354
CCoast North	Jump Across	48911	2963	145	24	1355	1439
CCoast North	Khutze	34321	1742	97	13	160	1472
CCoast North	Kilbella/Chuckwalla	71494	3881	3255	14	70	542
CCoast North	Kilippi	53373	1590	0	0	73	1517
CCoast North	Kiltuish	306	0	0	0	0	0
CCoast North	King Island	39779	5149	883	13	1474	2779
CCoast North	Klekane	20510	1914	301	20	310	1283
CCoast North	Kwatna/Quatlena	66949	5821	2804	142	1064	1811
CCoast North	Kynoch	46623	6	0	0	0	6
CCoast North	Labouchere	49591	4686	143	282	1540	2721
CCoast North	Laredo	52188	6617	0	23	328	6266
CCoast North	Lower Kimsquit	60100	3387	990	141	724	1532
CCoast North	Machmell	56398	4642	1534	0	698	2410
CCoast North	Nascall	55942	1269	8	24	444	793
CCoast North	Nechako	75458	0	0	0	0	0
CCoast North	Neechanz	47417	5319	897	24	831	3567
CCoast North	Nekite	21723	2984	161	303	261	2259
CCoast North	Nootum/Koeye	70786	28189	488	20	1017	26664
CCoast North	Nusatsum	47098	3579	1147	363	953	1116
CCoast North	Outer Coast	28034	113	112	0	0	1

	Islands						
CCoast North	Owikeno	37349	3937	312	42	1488	2095
CCoast North	Price	19726	155	0	7	0	148
CCoast North	Roderick	54083	8918	54	190	378	8296
CCoast North	Roscoe	37249	4044	189	81	649	3125
CCoast North	Saloompt	71187	5947	2424	93	1347	2083
CCoast North	Sheemahant	49745	5658	2308	351	512	2487
CCoast North	Sheep Passage	41253	1661	5	0	279	1377
CCoast North	Sigulat	86064	0	0	0	0	0
CCoast North	Smitley/Noeick	54183	5768	2164	763	1238	1603
CCoast North	Smokehouse	19	0	0	0	0	0
CCoast North	South Bentinck	42726	4342	1560	217	1168	1397
CCoast North	Sumquolt	53000	1439	0	0	134	1305
CCoast North	Surf	30121	1800	0	15	130	1655
CCoast North	Sutslem/Skowquiltz	63548	2084	158	1	625	1300
CCoast North	Swindle	35093	50	0	0	0	50
CCoast North	Talchako/Gyllenspetz	61176	3210	1596	17	704	893
CCoast North	Taleomey/Asseek	54225	4333	1670	61	1581	1021
CCoast North	Tolmie	21925	3554	0	0	35	3519
CCoast North	Triumph	123	0	0	0	0	0
CCoast North	Twin	37975	3474	1271	0	756	1447
CCoast North	Upper Kimsquit	52474	2465	324	0	670	1471
CCoast North	Upper Klinaklini	18355	0	0	0	0	0
CCoast North	Washwash	46879	1279	129	11	222	917
CCoast North	Water	172	120	5	16	66	33
CCoast North	Water/Dean-Burk Channel	733	166	11	10	101	44
CCoast North	Whalen	30594	2168	744	46	111	1267
CCoast North	Yeo	25485	4802	12	78	432	4280
CCoast North	Young	18873	0	0	0	0	0
CCoast North		26998	0	0	0	0	0
CCoast South	Ahnuhati-kwalate	31680	2005	384	312	792	517
CCoast South	Ahta	16270	4337	416	990	232	2699
CCoast South	Allison	59037	12668	1721	1623	465	8859
CCoast South	Atnarko	16	0	0	0	0	0
CCoast South	Belize	82023	9015	3829	2138	244	2804
CCoast South	Broughton	30109	20191	3561	3983	3737	8910
CCoast South	Charles	16057	1951	943	281	134	593
CCoast South	Doos/Dallery	353	14	0	0	0	14
CCoast South	Draney	26092	3224	1558	10	36	1620
CCoast South	East Knight	7	0	0	0	0	0
CCoast South	Estero	18695	8120	2056	1883	2914	1267
CCoast South	Franklin	71671	2679	807	523	1328	21
CCoast South	Fulmore	81282	44902	15073	17378	5072	7379
CCoast South	Gilford	63928	40181	14884	10845	5577	8875
CCoast South	Gray	26830	14972	5236	5240	2289	2207
CCoast South	Huaskin	41800	18529	5187	4752	437	8153
CCoast South	Kakweiken	36503	4707	1694	262	2358	393

CCoast South	Klinaklini Glacier	92241	835	44	479	312	0
CCoast South	Knight East	42823	8598	1021	2426	2283	2868
CCoast South	Lower Kingcome	48296	5523	3105	176	838	1404
CCoast South	Lower Klinaklini	64090	10819	2393	3001	5425	0
CCoast South	Lull-Sallie	30572	8379	1064	2196	1378	3741
CCoast South	Middle Klinaklini	92816	36	5	25	6	0
CCoast South	Miriam	19603	5996	605	1125	1095	3171
CCoast South	Neechanz	160	0	0	0	0	0
CCoast South	Nekite	46775	4644	1656	121	310	2557
CCoast South	Phillips	47210	12020	3291	416	517	7796
CCoast South	Seymour	42602	1967	1641	30	56	240
CCoast South	Sim	36482	1885	132	630	1067	56
CCoast South	Smith Sound	24323	3584	524	6	707	2347
CCoast South	Smokehouse	43767	3552	888	49	261	2354
CCoast South	Snowdrift	39948	11966	2625	1869	1080	6392
CCoast South	Stafford	57922	8829	398	2320	6066	45
CCoast South	Thurlow	42124	29494	10612	12759	4375	1748
CCoast South	Upper Kingcome	84692	4194	732	133	279	3050
CCoast South	Upper Klinaklini	106211	0	0	0	0	0
CCoast South	Wakeman	75229	8970	3372	41	1217	4340
CCoast South	Walker	1126	0	0	0	0	0
CCoast South	owater	1395	247	11	94	106	36
CCoast South		5408	222	26	89	21	86

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6.1.1.2 Base Case

7.1.1.1

Part 2

Environmental - Wildlife

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Section 2 Summary Matrix: Terrestrial Environmental Base Case

7.1.1.2 Biodiversity Account - Base Case Trends

7.2 Biodiversity • Ecosystem Representation • Old growth • Red and Blue-listed species • Riparian Habitats	• 10.7% of Plan Area in existing Protected Areas (PAs). However, significant gaps in ecosystem representation remain, particularly in the South Plan Area where no large (>3000 ha) PAs exist. Of the five major ecosections that occur in the CCLCRMP, only one is adequately represented (Kitimat, 18.5% provincially). Remaining 4 ecosections have less than 4% in PAs. Northern Pacific Ranges (NPR) most under-represented (2.2%). Many biogeoclimatic subzones lack representation in PAs including some that only occur in the CCLCRMP area (e.g., CWHvm3, CWHws2) • Although old growth forests may be maintained in areas outside the THLB, almost all of the old growth that occurs on the THLB is expected to decline in abundance over the next 50 years resulting in more early and mid seral stage forests. Species dependent on early seral forests are expected to benefit whereas species dependent on mature and old forests are expected to occur at lower densities and experience local declines. • However, mature/old forests that occur outside the THLB as well as current management practices/policies/regulations (e.g., FPC *Riparian Reserve Zones, Wildlife Tree Retention, Old Growth Management Areas, Identified Wildlife Management Strategy)* will partly reduce the risks to some environmental values (e.g., water quality, fish habitat, certain red-blue-listed plant and animal species. • Overall, natural levels of biodiversity expected to decline over the long term as undeveloped watersheds become roaded, the amount of mature and old coniferous forest declines and human disturbance increase. Implementation of policy direction set out in *Landscape Unit Planning Guide* (LUPG) further increases risks to biodiversity.
7.3 Wildlife	

8. **Marbled Murrelet**	• < 5% of marbled murrelet habitat in PAs/RAs. Majority of allocated to General Management in both the North (71%) and South (86%) plan areas. 20% and 39% of habitat occurs on the THLB in North and South Plan Areas respectively. • Upper slope nesting habitat (i.e. MH subzones) at less risk due to inoperability. However, valley bottom (CWH) nesting habitat remains at high risk from forest harvesting due to inadequate habitat protection measures (i.e. OGMAs and *Wildlife Habitat Areas* proposed in *Managing Identified Wildlife Strategy*). Application of LUPG limits the options to fully address habitat requirements.

8.1.1 *Grizzly Bear*	• In the North Plan Area, about 14% of high capability grizzly bear habitat allocated to relatively low risk management regimes (e.g., Recreation Areas, Protected Areas). The majority of remaining habitat, however, is allocated to General Management (73%). Some degree of landscape level protection provided in Mid-Coast Forest District (i.e., old forest seral targets in specific landscape units) partly reduces risks to grizzly bear habitat in the North Plan Area. • In the South Plan Area, no full protection of grizzly bear habitat exists, 91% of habitat currently in General Management. • Overall, current management practices suggest that although some stand-level management will likely occur (e.g., WHAs, buffering of avalanche chutes), lack of management direction from a *Higher Level Plan* poses increased risks to grizzly bears over the long term. Implementing landscape level requirements (e.g., seral stage distribution and access management) are needed to reduce risks associated with increased resource development activities.
8.1.2 *Black Bear*	• 27% and 13% of black bear habitat allocated to management regimes considered to pose relatively low risks to bears in the North and South Plan Areas respectively. In both Plan Areas, the majority (>70%) is allocated to General Management. • Overall, black bears including the Kermode bear remain vulnerable to resource development activities in both Plan Areas due to the lack of stand and landscape level management practices that are required to ensure critical foraging, security and denning habitats are maintained over the long term.
8.1.3 *Black-tailed deer*	• In the North Plan Area, relatively large amounts of deer winter range (40%) are allocated to areas that pose relatively low risks to deer populations. In addition, the Mid Coast Forest District further reduces risks to deer winter ranges by implementing a forest cover constraint (25% of deer winter range must be older than 250 years) which should provide adequate habitat over a rotation. In contrast, the South Plan, does not have any forest cover requirements to maintain deer winter ranges, which indicates deer winter range is at relatively higher risk in this portion of the CCLCRMP area.
8.1.4 *Moose*	• 38% and 31% of moose winter range occurs on the THLB in the North and South Plan Areas respectively. About 10% of moose winter range occurs in PAs in the North whereas only 1% in the South Plan Area. Majority of habitat allocated to General Management in both Plan Areas. • Overall, current management practices including old seral targets in the North Plan Area (i.e, grizzly areas) may be adequate to maintain portions of moose winter range in valley bottoms. However, further habitat management (stand/landscape) is required to maintain key moose winter range areas in both Plan Areas.
8.1.5 *Mountain Goat*	• In the North Plan Area, 3.0% of mountain goat winter range in existing Protected Areas and another 2.7% in Recreation Areas (RAs). No full protection for mountain goats in South Plan Area. Majority (> 87%) of mountain goat habitat, allocated to General Management in both Plan Areas. • Although current management practices (e.g., mine review process, establishment of WHAs in kidding areas) will help reduce risks to mountain goats, a comprehensive landscape level approach that addressing access management is required to reduce risks to mountain goats over the long term.

9. **9.1.1** *Karst Terrain* (unique carbonate or non-carbonate bedrock formations)	9.1.2 • Karst terrain vulnerable to degradation from forest harvesting and road construction. More detailed inventory of karst features required to ensure significant features are appropriately managed.

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10. 1.0 Introduction

The Central Coast Land and Coastal Resource Management Plan (CCLCRMP) covers an estimated 4.8 million ha on the coast of British Columbia, extending from Bute Inlet to Princess Royal Island and from the Queen Charlotte Sound in the west to Tweedsmuir Park in the east.

This section of the Base Case report summarizes the expected changes and relative risks to the environment (wildlife, fisheries, and marine resources) that would result if status quo management were to continue in the Central Coast LCRMP area. The purpose of the Base Case is to provide a benchmark by which the recommended Land Use Plan can be compared. The Base Case assumes a continuance of current management practices and attempts to address qualitatively the trends for each environmental value in the absence of a land use plan. Current management practices include all *Forest Practices Code* (FPC) regulations (e.g., *Riparian Reserve Zones*) as well as management direction set out in the recent *Landscape Unit Planning Guide* (1999). In addition, current management also includes resource management zones and guidelines outlined in various *Timber Supply Reviews (TSRs)* including the Mid-Coast (1999), Kingcome (1995) and Strathcona TSR (1999). Current management practices related to the mining sector include regulations outlined in the *Mines Act*, *Mineral Exploration* (MX) *Code*, *Mining Rights Amendment Act* and the *Environmental Assessment Act*.

The Central Coast LCRMP has been subdivided into two planning areas, the North Forum (3,085,991 ha), encompassing the entire Mid-Coast Forest District as well as 11 Landscape Units of the North Coast Forest District, and the South Forum (1,689,226 ha), representing portions of the Kingcome (Port McNeil Forest District) and Strathcona *Timber Supply Areas* (TSAs).

11. 2.0 Methods

11.1 2.1 Indicators

To compare the Base Case with the recommended Land Use Plan each environmental value requires a measurable criteria to be used as an **indicator**[62] to assist LCRMP participants determine if objectives for valued environmental components are likely to be achieved. Indicators for this assessment reflect environmental values identified by the Central Coast LCRMP Table.

BC Environment (Cariboo, Lower Mainland Region) provided wildlife habitat capability/suitability[2] maps (1:250,000) for five large mammal species including moose, black-tailed deer, mountain goat, black bear and grizzly bear. The suitability maps identified high value winter ranges for the ungulates and seasonally important habitats for bears. In addition, Marbled Murrelet habitat suitability (nesting) was also used as a wildlife indicator.

A Geographic Information System (GIS) was used to generate habitat area summaries which represented the amount of each mapped environmental indicator within each Resource Management Emphasis category (e.g., Visual Quality Retention zones). Although for some wildlife indicators the amount of *moderate* habitat suitability was used as the primary indicator (e.g., moose), for most species, the total area (ha) of *high* (Class 1) and *moderately high* (Class 2) rated habitats were combined to represent a single indicator. The main criteria used to assess each species account or environmental value (e.g., old growth) was the percentage of each indicator that occurred in each of the BEO/Resource Management Zones. Within each Resource Management Zone, the land base was further broken down into areas potentially available for forest harvesting, areas presently excluded from logging activities (i.e., "forested exclusions") and non-forested areas. The GIS area summaries are presented separately for the North and South Forums.

To best reflect existing land use intensities, a total of 5 resource management regimes were identified including:

- Existing Protected Areas
- Recreation Areas
- Preservation/Retention VQO
- Partial Retention VQO
- Deferral Zones in the North Plan Area, which represented areas deferred from forest harvesting pending First Nation Treaty negotiations.
- General Management (Forest Practices Code)

Because there is overlap between Protected Areas, Recreation Areas or VQO management and the BEO category, these management zones were treated as a separate category.

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[62] It is important to differentiate between indicators necessary to conduct the area analysis (i.e., *mapped* or spatial representations of resource values - **assessment indicators**) and those that are *not mapped* but still are critical to maintain environmental quality (e.g., sedimentation rates, concentration of water contaminants (ppm) - **monitoring indicators**). Although this analysis primarily used assessment indicators, other monitoring indicators were also considered if they were explicitly part of current management objectives and strategies.

[2] Capability is defined as the *potential* value of a habitat under optimum seral stage and management conditions whereas suitability refers to the *current* seral stage and condition of the habitat.

11.2 2.2 Assumptions

In order to estimate potential impacts to environmental values a number of key *assumptions* were required (Table 1). In addition, assumptions that are more species-specific were necessary and are defined for each wildlife species account. These assumptions were derived primarily from the published literature (see references), local knowledge and professional judgement.

Table 1. Key assumptions used to estimate potential land use impacts on environmental values.

- *The more closely managed forests resemble natural forest conditions, (i.e., maintain forest composition and stand structures) the greater the probability that populations of all native species will be maintained.*
- *Risks to biodiversity increase with increasing intensity levels of resource development. That is, lower intensity development areas provide more options and opportunities for maintaining native species and ecological processes.*
- *Plant and animal species with restricted ranges (e.g. islands, archipelago systems) are more vulnerable than widely distributed species.*
- *Fish and wildlife habitat that occurs on the timber harvesting land base (THLB) is at higher risk than excluded areas due to loss of unique valley bottom habitats, significantly altered seral stage distributions, road access and increased human disturbance. Although forested areas that occur outside of the THLB contribute to biodiversity, they do not necessarily provide adequate or equivalent habitat quality compared to areas that occur within the THLB. Establishment of Old Growth Management Areas (OGMAs), Wildlife Habitat Areas (WHAs) and Wildlife Tree Retention (WTR) within the THLB, however, are assumed to partly reduce the risks for some species. Similarly, riparian reserve zones and Landscape Unit seral retention partly reduce risks.*
- *Overall, landscapes dominated by younger seral forests, simplified stands (reduced forest structure), and smaller patches (i.e., reduced forest interior conditions and increased fragmentation) pose high risks to biodiversity.*
- *More open roads result in increased risk to specific species. In particular, increased road development results in greater mortality risks for large mammals (e.g., grizzly bears and ungulates) and potential habitat loss and fragmentation for smaller species (e.g., amphibians, small mammals).*
- *Access management strategies (e.g., permanent deactivation etc.), however, assumed to partly mitigate potential long-term adverse effects of increased road access from forest or mineral development.*
- *High Metallic Mineral Potential areas assumed to pose moderate to high risks to environmental values due to increased road access, ground disturbance, potential acid mine drainage and heavy metal leaching as well as increased human disturbance. All mitigation measures and environmental protection standards identified in the Mining Project Review Process and required under the Environmental Assessment Act assumed to partly reduce risks to some environmental values (e.g. water quality).*

These broad ***assumptions*** including the species-specific assumptions (see Fish / Wildlife sections) should be viewed as '***working hypotheses***' and should be continuously assessed through appropriate monitoring and further scientific investigation.

11.3

11.4 2.3 Risk Assessment

Using the quantitative GIS area summaries in combination with the assumptions, a relative *risk assessment* approach was used to assess the potential impacts of land use designations on each environmental value.

> *Risk is defined as the probability or likelihood of an adverse event occurring over the short or long term. For the purposes of this assessment, an adverse event or outcome includes such things as a significantly altered seral stage distributions, decrease in wildlife habitat quantity or quality, increased mortality, altered predator-prey relationships, population decline or reduced water quality/quantity.*

Potential causal factors that may result in one or more of these adverse outcomes include timber harvesting, mining, road development, increased human disturbance or over-harvesting (i.e., hunting, trapping, fishing). In general, risks were assumed to be positively correlated with increasing levels of land use intensity to reflect altered future landscape conditions. A brief rationale supporting each relative risk level and their significance is described below (Table 2.).

It should be emphasised, however, that Table 2 should only be considered as a rough guide to relative risk levels. Current management practices (e.g., FPC riparian reserve zones), and lower level planning processes as well as future management strategies outlined by the Central Coast LCRMP could partly mitigate potential negative impacts to environmental values and therefore, partly reduce the relative risk level. In contrast, weak or inadequate management practices including a lack of explicit management strategies within a Landscape Unit would increase relative risk levels.

Table 2. Relative risk levels used to estimate potential impacts of each land use category and Biodiversity Emphasis Option (BEO) on environmental values. Central Coast LCRMP.

Resource Management Zone Planning Unit Emphasis	Risk Level	Rationale and Implications
Protected Area	Low-Very Low	Resource development precluded; future landscape conditions anticipated to change the least. i.e., natural levels of biodiversity potentially maintained. Usually unroaded and undisturbed; wilderness values maintained. However, risks can be higher due to surrounding resource development activities (i.e., inadequate buffers). Overall, fish and wildlife populations expected to remain stable.
Deferrals	Short term - Low Long term - Unknown	Pending further negotiations with First Nations
Recreation Areas	Low-Moderate	Forest harvesting generally precluded; but, vulnerable to potential mineral exploration/ development and increased road access. Risks may vary (i.e., be higher) depending on the relative size of the *Recreation Area*, ecological values and probability of mineral development.
Visual Quality Objectives ***Preservation & Retention***	Low	Preservation areas netted out of timber harvesting land base; maximum of 5% disturbance (visibly altered) allowed in Retention VQO areas. Low

Resource Management Zone Planning Unit Emphasis	Risk Level	Rationale and Implications
		disturbance level results in relatively long rotation intervals and maintains supply of mature and old forest.
Visual Quality Objectives ***Partial Retention***	Low-Moderate	Maximum 15% disturbance allowed
General Management (Minimum FPC)	Moderate-High	Although the intent of the General (FPC) Management regime is often to balance economic and environmental values - species that require larger tracts of mature and old forest, less human disturbance become increasingly vulnerable. Risks may be very high if enhanced timber production as well as mineral development occurs simultaneously (i.e., cumulative effects). Mature and old-dependent species expected to occur at lower densities with the possibility of decline over the long term.

11.5

11.6 2.4 Implications of Landscape Unit Planning Guide

The recent release of the *Landscape Unit Panning Guide* (LUPG 1999) has important implications for biodiversity management in British Columbia. Specifically, the policy direction set out in the LUPG is not consistent with original intent of the *Biodiversity Guidebook* (1995). Because the LUPG does not require full implementation of the biodiversity recommendations[63] (*Biodiversity Guidebook* 1995) and has also made clear how mature and old forest requirements are to be met (i.e. largely in constrained areas) many species dependent on old forests remain vulnerable. Because the majority of landscape units in the Central Coast LCRMP will likely meet mature and old seral targets in areas outside the timber harvesting land base (due to steep terrain and large amounts of inoperable forests), representativeness of old forest ecosystems remain at risk. In summary, implementation of the management objectives and strategies outlined in the LUPG poses high risks to biodiversity because: (1) ecosystem representation is limited to the subzone/variant level, which further increases the risks to unique and rare valley bottom ecosystems; (2) early seral requirements no longer apply (all NDTs), which greatly increases the potential for early seral forests to significantly exceed natural levels (up to 5 times); (3) most landscape units in the CCLCRMP will meet mature and old seral stage objectives (OGMAs) in areas outside the timber harvesting land base (i.e. inoperable forested land), which will result in further concentration of forest development in productive valley bottoms and lower slope forests, and (4) only one-third of the old seral target is required in Low BEOs (~3-4%) which further increases the risks to plant and animal species dependent on old growth forests.

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[63] To meet full biodiversity objectives, the following stand and landscape level components are required : (1) species composition; (2) stand structure; (3) landscape connectivity: (4) old seral retention and representativeness; (5) temporal and spatial distribution of the cut and leave areas (i.e. patch distribution) and (6) seral stage distribution.

Further analysis during landscape unit planning will help determine the degree of risk for each landscape unit and biogeoclimatic subzone. Although the Ministry of Forests (directed by the Chief Forester) conducted a preliminary risk analysis of the variant level policy[64], the study results were inconclusive largely because there was difficulty in reaching a consensus about the impacts of forest management on biodiversity and appropriate risk levels. Despite the study design problems, the pilot data indicated that OGMA targets in the THLB can be similar under both variant and site series representation or site series representation may yield higher OGMA targets in the THLB compared variant representation. Although the site series that were under represented tended to be naturally rare and the total area required in the THLB to meet OGMA targets was small (less than 256 ha), site-specific data for each forest district would be required to determine which landscape units and site series are at risk.

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[64] Eng. M. and E. Hamilton. 1999. An analysis of the policy of variant level old forest representation. Ministry of Forests, Research Branch. http://www.for.gov.bc.ca/research/repbyvar/main.htm.

12. 3.0 Overview of the Ecology of the Central Coast Plan Area

To reflect the different climate and natural disturbance types regimes within the Plan Area, three broad ecological subunits have been identified including the Hecate Lowland, Outer Coast Mountains and Inner Coast Mountains (Pojar *et al.* 1999). Within these broader ecological units, a number of ecosections are represented and described briefly. The North forum of the Central Coast LCRMP area is represented by three ecosections including the *Kitimat Ranges* (KIR) which dominate the northern half, the *Northern Pacific Ranges* (NPR) which covers the southern half, and the *Hecate Lowlands* (HEL) situated on the outer coast. The South forum is dominated by the NPR, but is also represented by the HEL, *Outer Fiordlands* (OUF) and *Queen Charlotte Straits* (QCT) ecosections (Fig. 1). In addition, four other ecosections occur wholly within Tweedsmuir Provincial park including the *Nechako Upland* (NEU), *Nazko Upland* (NAU), *Western Chilcotin Uplands* (WCU), and *Western Chilcotin Rangelands* (WCR). Ecosystem representation, however, for these ecosections were dealt with during the Cariboo CORE and Lakes LRMP and therefore or not described in detail here. A brief summary of ecosection attributes and significant features that occur within the LCRMP boundary are listed below.

Northern Pacific Ranges Ecosection (NPR) – 45% of LCRMP

- Area of steep, ice-capped mountains, internationally significant mega-glaciers,
- Large conifers along coastal shoreline, old growth forests, Sitka spruce forest
- Coastal temperate rainforest, characterised by old western red cedar, Sitka spruce, yellow cedar, mountain hemlock/amabilis fir forests (subalpine), and old Douglas-fir and western hemlock (lower elevation)
- Bisected by internationally significant fjords, fjords lakes, extensive floodplains, estuaries, tidal marshes, hot springs and marine environments.
- Terrain highlighted by intertidal habitats (often along steep-sided fjords), and inlets, and in some portions, wetlands
- Multi-watershed grizzly/salmon ecosystems
- No entire watershed is fully protected; one is partially protected (Tweedsmuir protected 54% of the Bella Coola watershed)
- Predator-prey system includes wolves, mountain goats, and mule deer
- Accessible streams are critically important to fish, because of the lack of highly suitable habitat throughout the ecosection
- Pristine river valleys with little or no disturbance
- Grizzly bear/salmonberry alluvial floodplain sites
- Red and blue-listed species: Western Grebe, Brandt's Cormorant, Common Murre, Keen's long-eared myotis, Sitka spruce - salmonberry, Canada anemone, lesser saltmarsh sedge, short-beaked sedge, coast mountain draba, smooth willowherb

Kitimat Ranges Ecosection (KIR) – 22% of LCRMP (North Forum only)

- Massive rounded mountains of the Coastal Intrusion (granitic), dissected by spectacular fjords (internationally significant)
- Fjord lakes, fjord lagoons with tidal rapids, extensive floodplains
- Temperate rainforest with western hemlock, western red-cedar, yellow-cedar, amabilis fir
- Sub-alpine with mountain hemlock, amabilis fir, yellow-cedar
- Floodplains dominated by Sitka spruce, occasional black cottonwood and willows; estuaries, tidal marshes, marine environments

- Fish/wildlife include grizzly bear, black bear, mountain goat, salmonids, eulachon, waterfowl (over-wintering and migratory)
- Special features: spectacular fjords, hot springs, karst and limestone geology, fish/wildlife, estuaries, coastal temperate rainforest
- Red and blue-listed species: Gmelin's sedge, Regel's rush, mountain fern, lesser saltmarsh sedge.

Hecate Lowland Ecosection (HEL) - 17% of LCRMP

- A narrow band of coastal lowland and island archipelago
- Long, deep fjords, fjord lakes, fjord lagoons with tidal rapids; productive estuaries, protected inlets, sandy beaches
- Climate characteristically very wet, but less rainy than other coastal areas where Coast Mountain barrier is higher
- The mosaic of wetlands (bogs and fens), colloquially known as muskeg, sloped bogs, karst and limestone geology.
- Critical nesting and rearing areas for international waterfowl
- Peregrine Falcon, sea lion haul-outs, distinct wildlife populations on islands
- Inside passage marine route is internationally significant, high scenic values
- Red and blue-listed species: Pelagic Cormorant, Surf Scoter, Gmelin's sedge, yellow montane violet.

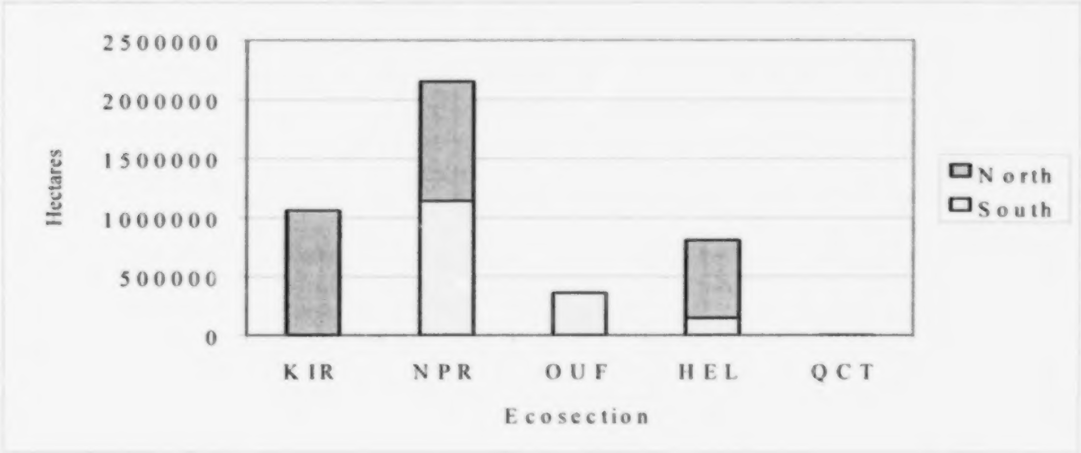
Outer Fiordland Ecosection (OUF) – 7.6% of LCRMP

- Area of rugged, low relief, consisting of inlets, sounds, islands and peninsulas
- Provides habitat for many rare seabirds
- Contains 7 primary watersheds in the 5-20,000 ha range (Moore 1991)
- Relatively undisturbed estuaries of minor rivers with exceptional fish and wildlife habitat
- Special features: Outer island archipelagos, resident cutthroat trout, steep-walled fiord edges
- Red and blue-listed species: Western Grebe, Marbled Murrelet, Lodgepole pine - Sphagnum, Western Hemlock, Smooth Douglasia, Two-edged Water Starwort

Queen Charlotte Strait Ecosection (QCT) – 0.06% of LCRMP

- Island groups and sheltered marine
- Intact small island vegetation communities
- Rocky intertidal algae, hard bottom habitats
- Sea cliffs and rocky islets
- Colonial breeding seabirds
- Shore scrub, and shore pine
- Red and blue-listed species: Pelagic Cormorant, Northern Sea Lions, Sea otter, Keen's Long-eared Myotis, Western Toad, Western Grebe, Harbour Seal, Gmelin's sedge, Cassin's Auklet, Rhinoceros Auklet

Fig. 1 Total area of each Ecosection within the Central Coast LCRMP area.



4.2 Biogeoclimatic Zones

Most of the following section has been extracted from Lewis *et al.* 1997. The Central Coast LCRMP area includes eight biogeoclimatic zones and 20 subzone/variants. Subzones consist of a sequence of lower case letters. The first letter indicates the precipitation regime; x= very dry, d = dry, m = moist, w = wet, v = very wet. The second letter is derived from the temperature (interior) or the continentality (coast) of the region. For the Central Coast region, the second letter delineates the continentality; h = hypermaritime, m = maritime, s = submaritime.
A brief description of each biogeoclimatic zone is provided below.

Alpine Tundra (AT) - found on the highest elevations within the Planning area. The AT is characterised by a cold, snowy and windy climate with a short growing season. Vegetation is stunted and consists mainly of krummholz type communities. Though the AT has not been differentiated into subzones, two distinct types, the coastal (ATc), and interior Alpine Tundra (ATi) occur in the northern Central Coast Planning Area.

Coastal Western Hemlock (CWH) - occurs at low- to mid- elevations, mostly west of the height of land coastal mountains, along the entire British Columbia coast. The CWH is, on average, the rainiest biogeoclimatic zone in British Columbia. However, certain subzones, such as the CWHds, have dry, hot periods in the summer. This zone typically has cool summers and mild winters.

There are 12 CWH subzone/variants present in the Central Coast Plan Area, including the:

- Coastal Western Hemlock very wet, maritime (CWHvm)
- Coastal Western Hemlock very wet, maritime, submontane variant (CWHvm1),
- Coastal Western Hemlock very wet, maritime, montane variant (CWHvm2)
- Coastal Western Hemlock very wet, maritime, montane variant (CWHvm3)
- Coastal Western Hemlock very wet, hypermaritime, southern variant (CWHvh1)
- Coastal Western Hemlock very wet, hypermaritime, central variant (CWHvh2),
- Coastal Western Hemlock moist, submaritime, central variant (CWHms2),
- Coastal Western Hemlock moist, submaritime, submontane variant (CWHmm)

- Coastal Western Hemlock wet submaritime, montane variant (CWHws2),
- Coastal Western Hemlock dry, maritime (CWHdm)
- Coastal Western Hemlock dry, submaritime central variant (CWHds2)
- Coastal Western Hemlock very dry, maritime western variant (CWHxm2)

Engelmann Spruce - Subalpine Fir (ESSF) - is the upper forested zone in the southern three-quarters of the interior of British Columbia. The ESSF occurs predominantly in mountainous terrain which is often steep and rugged. The ESSF has a relatively cold, moist, and snowy continental climate, and the growing seasons are cool and short while the winters are long and cold.

There are three subzones present in the northern Central Coast Planning Area, the Engelmann Spruce-Subalpine Fir moist, cold (ESSFmc), Engelmann Spruce-Subalpine Fir moist, cool (ESSFmk), Engelmann Spruce-Subalpine Fir moist, warm (ESSFmw), Mountain Hemlock -Engelmann Spruce-Subalpine Fir (ESSFmwh).

Mountain Hemlock (MH) - contains the subalpine elevations of the coastal mountains. The coastal subalpine climate is characterised by short, cool summers, and long, wet winters, with heavy snow cover. There are four subzones present in the Central Coast Plan area, the Mountain Hemlock moist maritime windward variant (MHmm1), Mountain Hemlock moist, maritime leeward variant (MHmm2); Mountain Hemlock moist, maritime leeward variant (MHmm2e) and Mountain Hemlock wet, hypermaritime windward variant (MHwh1).

13. 4.0 Protected Area Strategy

The *Protected Area Strategy* (PAS) is a provincial initiative designed to protect 12% of the provincial land base. Protected areas targeted for park status include large (>3000 ha) representative areas (Goal 1) as well as rare, unique, cultural and recreational features of the province (Goal 2).

13.1 4.1 Ecosystem Representation in Existing Protected Areas

13.2

The purpose of this section is to provide an area summary of existing ecosystem representation in fully Protected Areas and partially protected (Recreation Areas) within the North and South portions of the Central Coast LCRMP.

Situated within the northern portion of the Plan area, Tweedsmuir Provincial Park (379,514 ha) comprises the only large existing *Protected Area* within the Central Coast LCRMP boundaries. This portion of the TPP (~55,000 ha) provides representation of the *Kitimat Ranges* (KIR) ecosection and five biogeoclimatic subzones variants including the ATp, ESSFmw, MHmm2, CWHds2 and CWHws2. The Fiordland Recreation Area (76 561 ha) also provides representation of the KIR and four subzone/variants including ATp, CWHvm1, CWHvm2 and MHmm1. Also situated in the North plan area, the Hakai Recreation Area provide representation of the *Hecate Lowland* (HEL) ecosection and two biogeoclimatic subzone/variants including the MHwh1 and CWHvh2.

Except for some marine reserves, the South Plan area does not have any large (>3000 ha) protected areas that provide ecosystem representation. The Broughton Archipelago Marine Reserve is the largest (2 080 ha) and provides representation of the CWHvm1 and *Outer Fiordland* (OUF) ecosection. Although some subzone/variants may be lacking representation or be under-represented within the boundaries of the Central Coast LCRMP area, representation is provided by areas outside the CCLCMP (e.g., ESSFmk, MHmm1, CWHws2).

Provincial Overview

The TSA portions of Central Coast LCRMP area shares some common ecosections and biogeoclimatic zones with other forest districts that have existing Protected Areas. These include Vancouver Island, Kalum and the Cariboo-Chilcotin. The purpose of this section is to provide Table members with a provincial overview of existing representation for ecosections and biogeoclimatic subzone/variants that occur within the Central Coast LCRMP.

Of the five major ecosections that occur in the Central Coast LCRMP, only the *Kitimat Ranges* (KIR) is currently well-represented with 18.5% existing in fully protected or partially protected areas (Table 3). The majority of this representation comes from the Kitlope Heritage Conservancy, Fiordland Recreation Area and portions of Tweedsmuir Provincial Park. The remaining four ecosections, however, are under-represented (<4%) provincially, especially the *Northern Pacific Ranges* (2.2%).

Within the NPR, only 3 of 12 biogeoclimatic subzone/variants have adequate provincial representation (>12%) including 2 high elevation subzones (MHmm2e, ESSFmw) and 1 low elevation subzone (CWHds2). Alpine tundra (ATp), MHmm2 CWHvm1, CWHws2 and CWHms1 are poorly represented (1%-5%) and four subzone variants are completely lacking representation including the ESSFmw h, CWHvm2, CWHvm3, and the CWHdm (Table 3). It is worth noting that all (100%) of the ESSF mw h, CWHvm3 and the CWHws2 only occur in the CCLCRMP.

Although the KIR is relatively well represented (18.5%), there are gaps in biogeoclimatic subzone/variant representation. In particular, two subzones that only occur within the CCLCRMP are totally lacking representation including the CWHvm2 and the CWHms2 (Table 3).

Within the HEL ecosection, all subzones are currently under-represented (<8%) with one subzone lacking any representation (CWHmm1) (Table 3). The two subzones that occur in the QCT currently have minor representation (2-5%).

Table 3. Ecosection and biogeoclimatic subzone/variant representation in existing protected areas.

Ecosection	Subzone/Variant/ phase	Total area (ha) in CCLCRMP	Total area (ha) Provincial	% Protected in all existing PAs.
Northern Pacific Ranges (NPR)	ATp	789 368	1 350 208	1.9
	MH mm1	303 339	365 964	0.0
	MH mm2	183 377	278 223	2.2
	MH mm2e	2 696	5 521	20.0
	ESSF mw h	2 894	2 894	0.0
	ESSF mw	18 625	18 625	43.6
	CWH vm1	278 801	317 658	0.13
	CWH vm2	278 037	326 114	0.0
	CWH vm3	35 830	35 830	0.0
	CWH ws2	111 931	111 931	0.03
	CWHms1	0	74 278	4.4
	CWHms2	0	76 193	0.0
	CWHds1	0	71460	21.1
	CWH ds2	35 636	35 636	13.1
	CWH dm	1 756	25 249	0.0
	Lake	21 963	25 083	2.1
	TOTAL	**2 152 369**	**3 141 231**	**2.2**
Kitimat Ranges (KIR)	ATp	240 979	739 318	25.8
	MH wh1	0	24 967	0.0
	MH mm1	94 875	663 469	18.7
	MH mm2	94 674	270 406	14.6
	MH mm2e	1 608	1 608	0.0
	ESSF mk	919	120 986	21.8
	ESSF mw	33 660	33 660	74.5
	CWH vh2	1	56 238	0.0
	CWH vm	25 837	580 869	18.4
	CWH vm1	206 731	258 498	10.7
	CWH vm2	131 718	175 734	14.0
	CWH vm3	38 960	38 960	0.0
	CWH wm	0	2 109	0.0
	CWH ws1	0	104 366	0.4
	CWH ws2	70 353	260 262	21.7
	CWH ms2	51 719	51 719	0.0
	CWH ds2	45 549	45 549	26.4
	Lake	23 604	74 518	17.3
	13.2.1.1.1.1.1.1.1 T OTAL	**1 061 316**	**3 503 239**	**18.5**
Hecate Lowlands (HEL)	ATp	2 672	4 157	0.0
	MH wh1	23 460	110 976	1.06
	CWH vh1	122 598	122 598	0.0
	CWH vh2	613 299	1 212 581	4.8
	CWH vm1	1 663	1 663	0.0
	CWH vm2	8 738	8 738	0.0

	Lake	35 574	64 193	2.6
	TOTAL	**808 003**		**4.0**
Outer Fiordland (OUF)	ATp	999	1 071	6.8
	MH mm1	13 786	16 554	7.5
	CWH mm1	8 030	9 794	0.0
	CWH vm1	238 270	246 005	1.3
	CWH vm2	41 721	45 844	2.0
	CWH dm	18 697	48 962	7.3
	CWH xm1	0	104	100
	CWH xm2	26 642	55 518	8.6
	Lake	11 287	13 263	5.5
	TOTAL	**359 434**	**437 118**	**3.4**
Queen Charlotte Strait (QCT)	CWH vh1	1 184	12 319	4.8
	CWH vm 1	1 883	10 627	2.1
	Lake	0	252	0.0
	TOTAL	**3 068**	**23 198**	**3.5**

Source: LUCO; * Percentage includes Tweedsmuir, Recreation Areas (Hakai, Fiordland) and terrestrial portions of marine reserves

**Percentage represents other provincial/regional representation (Tweedsmuir, Kitlope)

14. 5.0 Biodiversity

14.1 5.1 Seral stage distribution and biodiversity implications

14.2

14.2.1 5.1.1 Background

As forest stands develop through time, the composition of plant and animal communities change. Some species are primarily associated with mature and old forests, while others use predominately early seral stages. Many plants and animals, however, use different seral stages throughout the year to meet seasonal requirements. To maintain biodiversity, the FPC *Biodiversity Guidebook* outlines seral stage objectives based on natural disturbance types (NDTs). Natural disturbances (e.g. fire, wind and insects) and their frequency have created forests with differing seral stage distributions. In general, forests with less frequent disturbances (e.g. CWH and MH habitats) tend to be older than those that are disturbed more frequently. Consequently, the types and numbers of plant and animal species adapted to each of these forest types vary. In general, species diversity tends to be greater in more productive valley bottom habitats.

Old growth forests contribute to overall biodiversity by providing structural attributes for many plant and animal species and by sustaining ecological processes including nutrient and water cycling. Old growth forests are often characterised by large old trees, multi-layered canopies, standing snags, and large logs on the forest floor (coarse woody debris) and in streams (large organic debris).

One of the primary threats to biodiversity is fragmentation of mature and old forests caused by forest harvesting practices and road development. Fragmentation is the process of reducing large contiguous forests into smaller forest patches and varies directly with the rate and pattern of timber harvesting. Fragmentation of old growth stands reduces the quality of wildlife habitats for several reasons including:

- the edges of old growth stands are poorer quality due to increased disturbance and climatic extremes;
- small stands are not suitable for species that require larger home ranges; and,
- animals moving between widely spaced old growth habitat may be subjected to higher rates of mortality.

For these reasons, the long-term viability of populations of some species may be lower in landscapes where their habitat is highly fragmented. Therefore, it is becoming widely recognised that forest management practices must be modified to better integrate timber harvesting and silviculture with ecological values. To achieve these objectives, especially for coastal forests that are naturally disturbed relatively infrequently (i.e., NDTs 1& 2), will require increased use of selection harvesting systems designed to retain old growth attributes.

14.2.2 5.1.2 Current Status and Anticipated Trends

The coastal temperate rainforest contains some of the most productive and biologically diverse forests in North America. Providing habitat for over 450 vertebrate species, the Coastal Western Hemlock (CWH) biogeoclimatic zone is the most productive zone in the plan area. The CWH comprises over half of the gross land base in both the North (51%) and South (58%) plan areas and represents virtually all (>98%) of the timber harvesting land base (THLB). That most of these productive old growth forests occur on the THLB together with the projected age class distributions reported in the *Timber Supply Reviews* (Mid-Coast , Kingcome and Strathcona TSAs) suggest these old growth forests are at high risk. The Mid-Coast TSA, for example, is currently dominated (~66% of TSA) by stands that are > 250 years old. Although a substantial area of old growth (>300,000 ha) is estimated to be maintained over time due to areas outside the timber harvesting land base (assuming no natural disturbance), almost all of the old growth that occurs on the THLB is converted to younger forests over the next 50 years. In contrast to the Mid-Coast TSA, the Strathcona TSA (1999) is currently dominated (66% of THLB) by forests less than 60 years old (TSR 1999) due to past harvesting history. Only about 17% of the stands in the THLB are older than 250 years with another 60% in areas outside the THLB. The age class projections indicate the remaining old growth that occurs in the timber harvesting land base will be harvested over the next 50 years leaving the majority of the THLB < 100 years old. Although there will be old growth forests (> 250 years) available in areas outside the THLB (assuming no natural disturbance) over time, unique old growth those ecosystems that only occur on the THLB remain at high risk. Similarly, the Kingcome TSA has a large proportion of the THLB in stands < 100 years old due past harvesting. However, almost half (47%) is > 120 years old with many stands older than 300 years. Although there will be some old forests maintained on the timber harvesting land base to meet visual quality and forest cover requirements for wildlife in the next 50 years, the projected age class distributions indicate the majority of forests will be <100 years old over the long term (> 100 years).

Although there were no timber supply forecasts available for the TFLs, overall, the projected age class distributions reported in the TSRs suggests old growth that occurs on the THLB remains at high risk over the short and long term. Although much of the mature and old seral forests may be maintained in inoperable areas and will partly contribute to the maintenance of biodiversity, ecosystems unique to valley bottoms will decline in abundance. Although these ecosystems could potentially recover, the overriding forest management objective of achieving a balanced age-class distribution precludes landscapes containing significant amounts of these old forests. Therefore, plant and animal species dependent on old growth communities remain at high risk, especially those that are relatively rare and have limited dispersal capabilities.

14.3 5.2 Red And Blue Listed Species/Plant Communities

The wildlife species and plant communities at risk in the Central Coast LCRMP are those identified by the *Conservation Data Centre* (MELP). Terrestrial wildlife species and rare plant communities known to occur in the North and South plan areas and considered at risk (provincial red & blue lists) are listed in Appendix 1. The red and blue listed plant communities in the Plan area include those that are:

(i) rare or uncommon on the landscape
(ii) contain unique species or elements
(ii) declining in representation due to alienation from the forest land base or stand conversion.

Within the Mid Coast Forest District, there are currently three red-listed and seven blue-listed bird species:

Red List

- Northern Goshawk (*laingi*) (*Identified Wildlife*)
- Marbled Murrelet (*Identified Wildlife*)
- Pelagic Cormorant (*pelagicus*)

Blue List

- Peregrine Falcon (*pealei*)
- Short-eared Owl
- American Bittern (*Identified Wildlife*)
- Sandhill Crane (*Identified Wildlife*)
- Trumpeter Swan (*Identified Wildlife*)
- Great Blue Heron
- Pine Grosbeak (*carlottae*)

There are also one red and three blue-listed terrestrial mammal species:

Red List

- Keen's long-eared myotis (*Identified Wildlife*).

Blue List

- Grizzly Bear (*Identified Wildlife*)
- Fisher (*Identified Wildlife*)
- Wolverine

In addition, there is one blue-listed amphibian (tailed frog) and one blue-listed freshwater fish (bull trout). There are also four yellow-listed bird species of management concern in the Central Coast LCRMP including the Brant, Rhinoceros Auklet, Harlequin Duck and Bald Eagle. In addition to these wildlife species, there is a very large number of rare ecosystems including 11 red-listed and 39 blue-listed plant communities (Appendix 1).

Many of the terrestrial red and blue-listed wildlife species as well as the rare plant communities that occur in the Mid Coast Forest District are also listed in the North Coast and Port McNeil Forest Districts (CDC tracking lists). In general, these districts appear to contain more threatened and vulnerable marine mammals and seabird species than the Mid Coast, however, many of them occur outside the Central Coast LCRMP.

14.3.1

14.3.2 5.2.1 Current Status and Anticipated Trends

Overall, the Base Case outlook for red and blue-listed wildlife species and rare plant communities is somewhat mixed. Although some wildlife species may be adequately addressed as part of the *Identified Wildlife Management Strategy* (IWMS) (e.g., wading birds), other species are either not currently identified in Volume 1 or have marginal habitat protection measures (e.g, Marbled Murrelet). Tailed frog habitat remains vulnerable because they use riparian forests and small non-fish bearing streams (e.g. S5) which have no riparian buffer zone under the FPC. Although nest trees are protected under the Wildlife Act, Northern Goshawk habitat remains vulnerable due to declining interior forest conditions. Furthermore, wildlife species that require landscape-level management objectives (e.g., grizzly bear, bull trout, fisher) remain at high risk due to a lack of higher level plan management direction.

Lastly, because the administrative process outlined for the establishment of WHAs appears somewhat lengthy and cumbersome, there is considerable uncertainty regarding when and how many WHAs will actually be approved.

The outlook for the significantly large number of rare plant communities (14 red listed and 39 blue-listed) also appear to be very poor. Although some representation of these ecosystems may be captured in inoperable areas, there is no habitat protection measures specifically designed to insure these habitats will be adequately represented on the landscape and continue to function as viable ecosystems.

5.3 Riparian Habitat

14.3.3

14.3.4 5.3.1 Background

Riparian habitats occur adjacent to water bodies including streams, rivers, lakes and wetlands.
Riparian vegetation (trees/shrubs) provides an unusually large number of functions including the regulation of light and temperature regimes, nourishment for aquatic and terrestrial biota and act as a source of large organic debris. In addition, riparian areas regulate the flow of water and nutrients from uplands to streams and maintain biodiversity by supporting numerous ecosystem types and ecological processes. Species diversity tends to be very high in riparian areas because of the multiple vegetation layers that provide a variety of nesting sites, cover areas and food sources. Maintaining riparian corridors is essential in managed forests because they help maintain fundamental ecosystem processes including species dispersal, predator-prey relationships and hydrological functions.

Some of the most diverse and dynamic riparian ecosystems are found in the Central Coast Plan Area. These habitats include floodplain forests, forested swamps, bogs, sedge wetlands and estuaries. Although estuaries comprise a small portion of the Central Coast LCRMP they provide important habitats for waterfowl, red and blue-listed bird species and are used extensively by salmon and grizzly bears. Some of the larger estuaries are found in the Kimsquit, Skowquiltz, Kingcome, Nekite, Stafford, Quatlena, Phillips, and Bentick Landscape units.

14.3.5 5.3.2 Current Status and Anticipated Trends

The maintenance of riparian habitats is currently addressed through the *Riparian Management Area Guidebook* (FPC 1995). Depending on the size of a particular wetland, lake or stream, there are regulations in place to help protect riparian values through the use of *Riparian Reserve Zones and Riparian Management Areas*. *Riparian Reserve Zones* are situated immediately adjacent to the body of water and vary in width from 10-50 m depending on the size of the riparian area. Within these zones no forest practices are allowed and are intended to maintain streambank stability and water temperatures.

A brief area summary of some key riparian ecosystems is provided in Table 4. The numbers represent how much of each broad ecosystem unit occurs in the Central Coast LCRMP area and how much occurs on the timber harvesting land base and at potential risk from forest harvesting.

These data indicate some riparian ecosystems are at higher risk than others as some ecosystems occur completely outside the current timber harvesting land base (e.g., Yellow Cedar Bogs) while are others have up to one-third on the THLB (e.g., Sitka Spruce-Cottonwood).

Table 4. Relative occurrence of riparian ecosystems (broad ecosystem units) in the North and South plan areas – CCLCRMP.

Riparian Ecosystem	Plan Area	Total (ha)	% in THLB	% outside THLB
Western Red Cedar-Black Cottonwood Riparian (RR)	North	1 832	0	100
	South	2 178	0	100
Sitka Spruce-Black Cottonwood Riparian (SR)	North	18 515	32	68
	South	18 727	21	79
Estuary (ES)	North	665	6	94
	South	1 286	14	86
Yellow Cedar Bog Forest (YB)	North	3 162	0	100
	South	3 892	0	100
Cedars-Shore Pine Bog (CB)	North	250 336	1-43*	99-57
	South	83 286	20	80

*varies according to site position; most CB ecosystems occur in inoperable areas: Source: MELP Broad ecosystem units (1:250,000)

14.3.6

14.3.7

The Mid Coast TSR (1999) assumed an average of 4.8% of the THLB would be zoned for riparian reserves zones. The Kingcome TSR (1995) netted out 1 351 ha for streamside buffers and another 2 750 ha for lakeshore buffers which represents about 2.2% of the THLB. How much of this applies to the CCLCRMP, however, is not clear. Similarly, the Strathcona TSR (1999) netted out 8 370 ha or 4.7% of the THLB, but how much applies to the CCLCRMP is also not known. Nonetheless, these riparian reserve net downs are required as part of the *Forest Practices Code* (FPC) and indicate current management practices (FPC *Riparian Reserve Zones*) are providing some riparian protection. However, since many recommendations (i.e., Best Management Practices) outlined in the *Guidebooks* remain discretionary, the degree to which riparian values are maintained is highly dependent on harvesting practices in the *Riparian Management Zone*. That is, maintaining mature and old forest attributes (e.g. wildlife trees) in areas outside the *Riparian Reserve Zone* will further reduce the impacts to riparian communities and processes. The benefits of leaving narrow (20-50 m) riparian buffer zones to terrestrial wildlife will have less of a positive impact and may even be detrimental to some species (e.g., increased predation). Although the relatively narrow buffers currently in use provide enhanced protection (compared to none), for some stream types, larger river systems would benefit from wider buffers to maintain ecological integrity of large river systems. Furthermore, wider buffers (e.g., 100-150 m) would provide better habitat for riparian wildlife associated with interior forest conditions (e.g., Pacific Slope flycatcher). Lastly, because many smaller streams (e.g., S4, < 1.5m) and adjacent forests also contain valuable fish and wildlife habitat, these habitats remain at risk because they do not have mandatory reserve zones.

In general, because riparian corridors are a key landscape feature, they need to be protected to effectively contribute to the maintenance of regional connectivity. In order to maintain hydrologic connectivity, the full range of riparian corridors from headwaters to sea must receive management attention. Other concerns related to riparian values include the absence of Lake Classification and lakeshore buffer guidelines in portions of the CCLCRMP.

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17.

18. 6.0 Wildlife

18.1 6.1 Marbled Murrelet

18.1.1 6.1.2 Background

The Marbled Murrelet is a robin-sized seabird which feeds in the open sea and nests in stands of old-growth forest within 80 km of the coast[65]. Marbled Murrelets are currently *red-listed*[66] (endangered) in British Columbia because they have a low reproductive rate, and are vulnerable to timber harvesting of old-growth forests that provide critical nesting habitat.

Old-growth conifers (preferable age class 9) provide large, flat, mossy branches to nest on and the height needed for birds to pick up flying speed. The relatively open crown canopies provide ready access for murrelets arriving at or leaving the nest. Conifers need to be at least 150 years old to have the flat tree branches and thick moss needed to support a murrelet nest. In south coastal BC., all nesting appears to occur in old-growth forests and possibly mature forest. Although murrelet nests have been found in old growth forests containing a number of conifer species, Sitka spruce and western hemlock appear to have the most suitable branch structure and number of platforms to support murrelet nests (Rodway and Regher 1999). Murrelet nests have been found from near sea-level to an elevation of 710 m.

Murrelet numbers are very low in old-growth stands smaller than 40 ha, while stands larger than 200 ha have been reported to support high numbers. Savard (personal communication) noted higher detection rates in bottoms of valleys (below 500 m) and lower detection rates at higher elevations. However, recent studies in the Central Coast LCRMP have noted reasonably high detection rates in watersheds that have been heavily logged (e.g., Chuckwalla/Kilbella), which suggest upper slopes can provide potential habitat if adequate quantities and suitable attributes are present (Schroeder *et al.* 1998). In general, however, there appears to be a positive relationship between bird density and availability of suitable habitat, which suggests murrelet density will decline as suitable habitat declines. Because murrelets do not nest in colonies, relatively large habitat areas need to be set aside to protect small parts of the population (Rodway 1990). Selection silvicultural systems leave suitable nest trees which may be used by nesting birds, but their response to habitat disturbance needs further study (Rodway 1990).

The indicators and assumptions used to estimate potential impacts on Marbled Murrelet nesting habitat are shown in Table 5.

Table 5. Indicators and Assumptions used to estimate potential impact of Resource Management Regimes (RMR) on Marbled Murrelet Habitat – Central Coast LCRMP. Base Case

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[65] For a more comprehensive account of Marbled Murrelet ecology see marine section pp.

[3] BC Environment uses a 3-class system to rank vertebrate species according to their provincial degree of endangerment. *red-list* = endangered; *blue-list*-vulnerable/sensitive; *yellow-list* = not at risk, but may be regionally significant

Indicator	Assumptions
(1) *Percent of High and Moderately High suitability Marbled Murrelet habitat in each Resource Management Regime category* (2) *Percent of High and Moderately High suitability habitat that occurs on the timber harvesting land base (THLB).* (3) *The amount of THLB that contains preferred nesting habitat (i.e. CWH vh, CWH vm).*	• Wetter climates of CWHvh and CWHvm subzones generally provide preferred nesting habitat compared to drier CWH (e.g., CWHxm) and MH subzones due to larger limb development and abundance of moss growth of trees. • Valley bottom forests that contain Sitka spruce and western hemlock often support preferred nest trees. • Larger contiguous areas of old forests are preferred over smaller and fragmented areas. • *Wildlife Habitat Areas* (IWMS) considered to partly reduce impacts; however nesting habitat that occurs on the THLB remains vulnerable (i.e. WHAs = OGMAs from non-contributing land base). • Seasonal closures of resource development activities during nesting period considered to partly reduce risks.

18.1.2 6.1.3 Current Status and Anticipated Trends

Although there is a similar amount of high suitability Marbled Murrelet nesting habitat in both the North and South plan areas, the distribution of habitat differs (Table 6). Class 1 (high) habitat is concentrated in the Kilbella/Chuckwalla, Clyak and Kwatna/Quatlena Landscape Units in the North plan area whereas in the South plan area Class 1 (High suitability) habitat is widely distributed throughout most of the Landscape Units (see Appendix 2.0 - mapped distribution of marbled murrelet habitat in the CCLCRMP area).

In the North plan area, the GIS area analysis indicated about 20% of Marbled Murrelet nesting habitat occurs on the timber harvesting land base and is considered at high risk from forest harvesting and road development (Table 6). About 55% of Marbled Murrelet habitat exists in forested exclusions. At present, only about 5% of the gross amount of Marbled Murrelet habitat occurs in low risk Resource Management Regimes (i.e., Protected and Recreation Areas) and another 23% in Retention and Partial Retention VQOs, which are considered to pose low to moderate risks to murrelet nesting habitat. The remaining nesting habitat (71%) is allocated to General Management (Table 6). Of the habitat that occurs on the timber harvesting land base, 85% (35, 663 ha) is allocated to General (FPC) Management.

In the South plan area, about twice (39%) as much Marbled Murrelet habitat occurs on the THLB as the North plan area. The majority (88%) of the gross amount of nesting habitat is distributed among the various BEOs with about 11% overlapping with VQO management. Of the habitat that occurs on the timber harvesting land base, 85% is allocated to General Management. Less than 1% of Marbled Murrelet habitat occurs in Protected Areas (Table 6).

Table 6. Areal breakdown of High /Moderately High Suitability Marbled Murrelet Habitat in each Resource Management Regime (RMR) category. Central Coast LCRMP – Base Case
NORTH PLAN AREA

Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
Deferrals	512	621	18	1,151	**0.6**
Existing Protected	67	7	0	74	**0.04**
Recreation Areas	5,575	4,509	0	10,084	**4.8**
Retention VQO	7,433	2,638	1,832	11,913	**5.7**
Partial Retention VQO	23,974	8,017	4,260	36,251	**17.3**
General Management	77,999	37,010	35,663	148,682	**71.4**
Total Marbled Murrelet Habitat (%)	115,560 **(55.0)**	52,802 **(25.0)**	41,773 **(20.0)**	208,155 **(100.0)**	**100**
SOUTH PLAN AREA					
Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
18.1.2.1.1.1.1 Existing Protected	1,359	80	25	1,464	**0.9**
Retention VQO	1,554	234	1,244	3,032	**1.8**
Partial Retention VQO	5,121	910	8,654	14,682	**8.9**
General Management	67,371	23,928	55,244	146,545	**88.5**
Total Marbled Murrelet Habitat (%)	75,405 **(45.5)**	25,152 **(15.2)**	65,167 **(39.3)**	165,724 **(100)**	**100**

Although the Marbled Murrelet is considered an *Identified Wildlife* species and habitat protection measures have been outlined in the *Identified Wildlife Management Strategy* (IWMS), the wildlife habitat areas (WHAs) must be contained within the old growth seral targets (OGMAs). Because OGMAs will largely be met in areas outside the timber harvesting land base, potential nesting sites that occur on the THLB remain at highest risk. Moreover, because the THLB occurs predominately in CWH subzones, which contains some of the most suitable nesting habitat further suggests the impact is somewhat greater than the area overlap indicates. In fact, in the North and South plan areas respectively, about 63% and 86% of the THLB is comprised of two subzones known to have high suitability nesting habitat (CWHvh and CWHvm).

Although the IWMS attempts to provide habitat protection for Marbled Murrelets, the WHA planning objectives limit the amount of habitat allocated to WHAs to 10-12% of the combined total area of suitable habitat, which also indicates a large proportion of habitat, remains vulnerable to forest development. Overall, the GIS area statistics, projected age class distributions (TSRs) and current management practices (IWMS) suggest habitat suitability will decline in both the North and South plan areas over time. Nesting habitat may be at relatively higher risk in the South plan area due to the relatively high proportion of habitat that occurs on the THLB (39%) and the greater amount of harvesting that has already occurred. Although *Wildlife Tree Patches* (WTPs) and *Riparian Reserve Zones* will potentially maintain some suitable nest trees, they will occur in a matrix of early seral forests which effectively reduces interior forest conditions necessary to maintain suitable habitat at the landscape level.

18.2 6.2 Grizzly Bear

18.2.1 6.2.1 Background

Grizzly bears are provincially *blue-listed*[67] primarily because they require large wilderness areas, have low reproductive rates and are vulnerable to human disturbances. To reduce bear-human conflicts, it is generally accepted that grizzly bears require large relatively undisturbed areas (350-2500 km^2 for an adult male). However, because large undisturbed areas exceeding thousands of square kilometres are rare, the majority of grizzly bear range will require some form of special management to ensure grizzly bear survival.

Grizzly bears require a variety of seral stages to meet seasonal habitat requirements. Important habitats for coastal grizzly bears include salmon-bearing streams, estuaries, skunk cabbage swamps, mature floodplain forests, avalanche chutes, and non-forested fen/marsh complexes. In addition, habitats that provide abundant berry-producing shrubs (e.g. salmonberry, devil's club, and red elderberry) are used extensively as foraging areas throughout the summer months.

Most of the potential threats to coastal grizzly bear populations are related to human access, which results in higher mortality rates. Because road access poses high risks to grizzly bear survival, the amount of land remaining unroaded or where road densities are minimised typically provides the least risk to grizzly bears. Resource development activities, especially clearcut logging, also result in direct loss of habitat as well as habitat displacement from preferred foraging/security areas. Other risk factors include current coastal logging and intensive silviculture practices, which can reduce the amount of berry-producing shrubs and herbs by favouring early conifer establishment and high stocking densities.

Because grizzly bears are sensitive to specific land uses, sub-regional planning processes (LRMPs) can provide the necessary spatial scale (i.e., thousands km^2) to meet their needs for relatively large areas. To address this requirement, the *Grizzly Bear Conservation Strategy* (1995) recognised land and resource management planning processes as the primary initiative to address landscape level requirements including the establishment of Grizzly Bear Management Areas (GBMAs). As such, grizzly bears are considered a higher level plan species where additional management direction is needed to meet their landscape level requirements, especially as they relate to seral stage distribution and road access.

A list of assumptions used to estimate potential impacts of land use practices on grizzly bears are outlined in Table 7.

Table 7. Indicators and assumptions used to estimate potential impact of Resource Management Regimes (RMR) on Grizzly Bear Habitat. Central Coast LCRMP-Base Case.

Indicator	Assumptions

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[67] BC Environment uses a 3 class system to rank vertebrate species according to their provincial degree of endangerment. *red-list* = endangered; *blue-list*-vulnerable/sensitive; *yellow-list* = not at risk, but may be regionally significant

(1) Percent of High capability grizzly bear habitat in each Resource Management Regime category *(2) Percent of High capability grizzly bear habitat that occurs on the timber harvesting land base.* (3) *The number of landscape units remaining undeveloped (i.e., proposed protected areas); their size and how they are spatially distributed*	• The abundance and quality of salmon spawning habitat (riparian areas) directly affects grizzly bear survival (Bear-salmon interactions). • The presence of roads affects bears by increasing human access to bear habitat and potentially reducing salmon productivity (i.e., increased sediment). • Seasonal, semi-permanent and permanent deactivation of roads assumed to partly mitigate impacts of road access; but less preferred than unroaded areas. • Undeveloped watersheds provide the least risk to grizzly bear survival. Larger protected areas (100-1000 km^2) are better than smaller areas. Connected areas are better than disjointed areas. Protected Areas preferred land use designation (low risk).

18.2.2 6.2.2 Current Status and Anticipated Trends

The Central Coast Plan area includes some of the highest capability grizzly bear habitat in the province. In the North plan area, high capability grizzly bear habitats are widely distributed, but key grizzly bear-salmon ecosystems are found in the following Landscape Units:

- *Upper and Lower Kimsquit*
- *Sutslem/Skowquiltz*
- *Bella Coola*
- *Clyak*
- *Kibella/Chuckwalla*
- *Sheemahant*
- *Macmell*
- *Neechanz*
- *Doos/Dallery*
- *Kwatna*
- *Nootum Koeye*
- *Fjordlands Recreation Area*

In the South plan area, Landscape Units that provide key grizzly bear-salmon ecosystems include:

- *Ahta*
- *Annuhati-kwalate*
- *Kakweiken*
- *Nekite*
- *Lower Klinaklini*

- *Sim*
- *Wakeman*
- *Draney*
- *Stafford*
- *Phillips*

In total, about 665,000 ha and another 502,000 ha of high capability grizzly bear habitat have been identified in the North and South plan areas, respectively (see Appendix 2.0 - mapped distribution of grizzly bear habitat in the CCLCRMP area). In the North plan area, 16.4% of grizzly bear habitat occurs on the timber harvesting land base (THLB). The remaining habitat occurs in forested (39%) and non-forested exclusions (44%; Table 8).

Because habitats that occur on the THLB receive extensive seasonal use by grizzly bears, they are at potentially high risk over the short and long term. To partly address these concerns, current management practices outlined in the recent Mid Coast TSR (1999) state that, in 17 high value grizzly bear landscape units, about 10,000 ha or 5.5% of the THLB will be maintained in stands older than 250 years to meet grizzly bear habitat objectives. This represents about 10% of the total grizzly bear habitat that occurs on the THLB, which will be maintained in a late seral condition. This roughly translates into about 500-600 ha of old growth per landscape unit (i.e.10, 000 ha/17) that will be maintained specifically to provide grizzly bear habitat. Whether this can be considered incremental to existing constraints (e.g., riparian reserves) is not clear at this time.

In total, about 14% of high capability grizzly bear habitat in the North plan area are in designations considered to pose relatively low risks to bears (i.e. Tweedsmuir Provincial Park and Fiordland Recreation Area). Another 13% occur in VQO zones (retention/partial retention) with the majority of remaining grizzly bear habitat (72%) to the General FPC Management regime. (Table 8).

Table 8. Areal breakdown of High Capability Grizzly Bear Habitat in each Resource Management Regime (RMR) category. Central Coast LCRMP – Base Case

NORTH PLAN AREA

Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
Deferrals	4 344	8 935	1 925	15 205	**2.3**
Existing Protected	23 346	27 389	83	50 718	**7.6**
Recreation Areas	7 086	21 263	0	28 350	**4.3**
Retention VQO	10 559	6 899	3 564	21 022	**3.2**
Partial Retention	32 131	25 255	10 780	68 166	**10.2**
General Management	185,312	204,728	92,879	482,919	**72.5**
Total Grizzly Bear Habitat (%)	262 207 (39.4)	294 449 (44.2)	109 242 (16.4)	665 899 (100)	**100**

SOUTH PLAN AREA

Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR**
18.2.2.1.1.1.1 Existing Protected	339	40	22	401	**0.08**
Retention VQO	2 097	339	3 540	5 976	**1.2**
Partial Retention	11 653	4 057	22 641	38 351	**7.6**
General Management	176,323	144,681	134,899	455,903	**90.7**

Total Grizzly Bear Habitat (%)	190 610 (37.9)	150 868 (30.0)	161 189 (32.1)	502 666 (100)	**100**

In the South plan area, about twice as much grizzly bear habitat occurs on the timber harvesting land base (32%) compared to the North. In addition, there are no designated areas that currently provide full protection (e.g., PAs) or management strategies specifically designed to maintain grizzly bear habitat on the timber harvesting land base. This suggests that grizzly bears are at relatively higher risks in the South plan area compared to the North plan area. However, there are some potential offsetting benefits in the South plan area where some known key grizzly bear/salmon ecosystems will be managed using more appropriate seral stage targets (e.g., Annuhati-Kwalate). The removal of the Smokehouse and Klinaklini areas from the timber harvesting land base (due to low timber values and access problems) also reduces the risks to grizzly bear/salmon systems.

Without restricting the maximum amount of early seral forest present in a landscape unit at any given time, potentially high proportions of the timber harvesting land base will eventually be represented by closed canopy second growth conditions which do not provide suitable grizzly bear foraging habitat. Although non-forested feeding areas (e.g., wetlands, estuaries) are not at risk from forest harvesting, removal of forested stands near these high value feeding areas will indirectly reduce their suitability. Although implementing silvilcultural regimes (spacing) as outlined in the *Guidelines for Integrating Coastal Grizzly Bear Habitat and Silviculture in Coastal British Columbia* may partly mitigate the effect of high conifer densities, they are currently being applied on an ad hoc basis and only for high brushy site series (i.e. they are not being applied over large areas).

Overall, current management practices suggests some stand level protection for grizzly bears will continue to take place (e.g. leave strips along avalanche chutes, potential establishment of WHAs) in both the North and South plan areas. In addition, the Mid Coast Forest District will also provide some landscape level protection by maintaining a portion of late seral forests in 17 high value grizzly bear landscape units. However, to fully meet critical stand and landscape level requirements for grizzly bears in both the North and South plan areas, explicit direction from a higher level plan is needed to adequately reduce the risks over the long term. As outlined in the IWMS, higher level plan direction should include setting seral stage objectives and implementing comprehensive co-ordinated access management planning to meet grizzly bear management objectives. Without this direction, grizzly bears will remain vulnerable over the short and long term in the Central Coast LCRMP.

18.3 6.3 Black and Kermode (white) Bear

18.3.1 6.3.1 Background

The Central Coast LCRMP area supports numerous black bears (*Ursus americanus*) including the white phase of the black bear known as the Kermode bear (*Ursus americanus kermodei*). Within the Central Coast LCRMP, Kermode bears are most abundant on Princess Royal Island but also occur on Roderick and Swindle Islands as well as adjacent mainland portions north of the Dean Channel (Blood 1997). Of the estimated 400 bears on Princess Royal Island, about 10% (40) are estimated to be white phase bears. There is no open hunting season on white-phase bears.

Like grizzly bears, coastal black bears require a variety of habitats to meet seasonal feeding requirements, especially salmon-bearing streams. In addition, black bears also use large old trees (e.g., western redcedar) as winter den sites, which are most abundant in mature and old forests. Risk factors to black bears include loss of critical feeding habitats, and denning habitat, altered seral stage distributions, road access and bear-human conflicts.

Table 9. Indicators and assumptions used to estimate potential impact of Resource Management Regimes (RMR) on Black Bear Habitat. Central Coast LCRMP - Base Case.

Indicator	Assumptions
1) Percent of High suitability black bear habitat in each Resource Management Regime category *2) Percent of high suitability black bear habitat that occurs on the timber harvesting land base.*	• The abundance and quality of salmon spawning habitat (riparian areas) directly affects black bear survival (Bear-salmon interactions). • The presence of roads affects bears by increasing human access to bear habitat and potentially reducing salmon productivity (i.e., increased sediment).. • Seasonal, semi-permanent and permanent deactivation of roads assumed to partly mitigate impacts of road access but less preferred than unroaded areas. • Undeveloped watersheds provide the least risk to black bear survival. • The significance of estimated risks is somewhat greater for white phase black bears (Kermode bear) due to their restricted distribution and natural rarity.

18.3.2

18.3.3

18.3.4 6.3.2 Current Status and Anticipated Trends

In the North plan area, the GIS area analysis indicated only10% of high suitability black bear habitat occurs on the timber harvesting land base (THLB) (Table 10). The majority of black bear habitat consists of non-forested areas (51%) as well as forested areas outside the THLB (39%, Table 10). In the South plan area, however, substantially more habitat (29%) occurs on the THLB (Table 10). Although these percentages can be viewed as relatively low, it is important to recognise that many critical seasonal bear habitats only occur on or near the timber harvesting land base which results in concentrated use during seasonal periods.

In the North plan area, about 27% of high suitability black bear habitat occurs in management regime categories considered to pose relatively low risks to black bears (i.e. Protected/Recreation Areas/VQOs) whereas in the South plan area, only about 13% of black bear habitat is allocated to these moderately low risk management regimes (Table 10). The majority of black bear habitat (>70%) in both plan areas, however, is allocated to the General Management regime (Table 10). Overall, the relatively higher amount of bear habitat that occurs on the timber harvesting land base combined with very little full protection (<1%), suggests black bears are at relatively higher risks in the South plan area compared to the North plan area.

The outlook for the Kermode bear, however, is somewhat uncertain and largely dependent on whether the proposed Study Area (Spirit Bear) becomes a Class A park or, if not, how well forest management practices will integrate the needs of bears on Princess Royal Island. Current management practices, however, suggests very little integration of bear habitat requirements into forest management planning is being done. Other than maintaining riparian reserve zones and occasionally identifying bear den trees, there are no stand or landscape level management practices in place that ensure critical foraging, security and denning habitat is maintained. At present, there also is no information regarding TFL harvest forecasts to provide an indication of age class distributions over time.

Table 10. Areal breakdown of High Suitability Black Bear Habitat in each Resource Management Regime category. Central Coast LCRMP

NORTH PLAN AREA

Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
18.3.4.1.1.1.1 Deferrals	4,657	14,468	1,815	20,940	**1.8**
Existing Protected	74,788	40,999	92	115,879	**9.9**
Recreation Areas	11,840	27,207	1	39,049	**3.3**
Retention VQO	17,552	10,970	5,632	34,154	**2.9**
Partial Retention VQO	70,609	42,583	16,326	129,518	**11.1**
General Management	280,507	455,137	93,500	829,144	**70.9**
Total Black Bear Habitat (%)	459,953 **(39.4)**	591,364 **(50.6)**	117,366 **(10.0)**	1,168,684 **(100.0)**	**100.0**

SOUTH PLAN AREA

Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
18.3.4.1.1.1.2 Existing Protected	2,081	91	93	2,265	**0.3**
Retention VQO	5,311	1,344	6,311	12,967	**1.8**
Partial Retention VQO	25,402	7,383	44,424	77,209	**10.8**
General Management	215,245	247,886	158,518	621,647	**86.7**
Total Black Bear Habitat (%)	248,039 **(34.7)**	256,704 **(36.0)**	209,346 **(29.3)**	714,088 **(100.0)**	**100.0**

Although access management is a concern, the relatively remote locations of many outer coast islands and rugged terrain of the inner coast suggests deactivation provisions outlined in the *Forest Practices Code* should adequately reduce the risks associated with increased access over the long term.

Overall, black bears and in particular, the Kermode bear, will require landscape management direction that ensures viable populations over the long term. This will require addressing population linkages (islands, mainland) and maintaining critical foraging and security areas over relatively large areas. Without a comprehensive landscape level approach, they will remain vulnerable to continued forest and road development.

18.4 6.4 Black-tailed Deer

18.4.1

18.4.2 6.4.1 Background

Areas of high suitability winter range occur in mid elevation, mature and old seral CWH forests across much of the plan area. High habitat values are usually associated with steep south-facing slopes that have a high component of Douglas-fir, which provide snow interception and thermal cover. However, because of the moderating effect of the ocean along the Pacific coast, deer that live near the outer coast generally do not have the same stringent winter habitat requirements as deer that occur in more interior locations of the Plan area, which receive more snow accumulation. Stands that provide both mature coniferous trees and natural openings tend to receive the most use by deer because they provide both snow interception, thermal cover and shrub forage sources in close proximity. During severe winters, deer prefer old growth forest habitat to early successional stages. Typically the overstorey consists of Douglas-fir or western redcedar with a canopy closure >60%. The understorey is dense with abundant ferns and shrubs. Arboreal lichens found in old-growth forests are also important in deer winter diets and may not be produced in adequate amounts in coniferous forests under 100 years old.

In order to maintain deer winter range, these attributes must be available throughout a rotation.
Second growth stands may be able to maintain old growth attributes if appropriate silvilcultural prescriptions are developed.

Table 11. Indicator and Assumptions used to estimate potential impact of Resource Management Regimes (RMR) on Black-tailed Deer Habitat – Central Coast LCRMP. Base Case

Indicator	Assumptions
(1) Percent of High suitability black-tailed deer winter range in each Resource Management Regime (RMR) category (2) *Percent of High suitability winter range that occurs on the timber harvesting land base.*	• Mature and old forests provide critical winter habitat (snow interception) for coastal deer populations during years with heavy snow accumulation. Therefore, for long-term population viability, these habitats must be available throughout a rotation and be appropriately distributed (spatial/temporal) within a landscape unit. • Increased road development provides access to deer by wolves, cougars and humans which poses high to very high risks to deer survival. • However, access management strategies or seasonal closures during resource development activities considered to partly reduce risks.

18.4.3

18.4.4 6.4.2 Current Status and Anticipated Trends

18.5

Coastal black-tailed deer are estimated to be relatively abundant throughout the Central Coast LCRMP area. Areas of high suitability winter range occur in the CWH biogeoclimatic zone and include low-elevation mature and old forests dominated by Douglas-fir, western redcedar and yellow cedar.

The GIS area analysis indicated about 15% of high suitability black-tailed deer habitat occurs on the timber harvesting land base (THLB) in the North Plan Area (Table 12). About half (51%) of the remaining forested portions of deer winter range exists in areas outside the THLB (Table 12). In the North plan area, approximately 40% of deer winter range occurs in management areas that pose relatively low risks to deer (i.e. VQO's, Recreation and Protected Areas) and the remaining 62% is allocated to General Management (Table 12). Although these areas could be at potentially high risk, the recent timber supply analysis for the Mid Coast TSA addresses deer winter range values. Specifically, the Mid Coast TSR (1999) applied a forest cover requirement to areas that have deer winter range potential for both outer coast and inner coast portions of the Mid Coast TSA. Within the inner coast, management objectives for deer winter range were applied to the CWHds2 and CWHms2 subzone/variants that have Douglas fir/cedar leading stands. In the outer coast, deer management areas include red cedar/yellow cedar stands found within the CWHvm1,vm2,vm3 and CWHch2 subzone/variants. Within these stand types, a minimum of 25% of the stands must be older than 250 years.

Although further work is required to refine deer winter range boundaries throughout the entire Plan area, these age class objectives suggests adequate quantities of mature/old forests will be available throughout a rotation. Therefore, there appears to be relatively low risks to deer winter range in these areas. However, until all known deer winter ranges have been identified there remains some uncertainty and risk to maintaining the full complement of deer winter range values over the entire plan area.

Table 12. Areal breakdown of High Suitability Black-tailed Deer Winter Range in each Resource Management Regime (RMR) category. Central Coast LCRMP – Base Case

NORTH PLAN AREA

Resource Management Regime (RMR) Category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
18.5.1.1.1.1.1 Deferrals	1,268	678	809	2,755	**1.6**
Existing Protected	2,517	2,211	18	4,747	**2.8**
Recreation Areas	6,995	6,657	1	13,653	**8.2**
Retention VQO	7,491	2,396	2,287	12,174	**7.3**
Partial Retention VQO	18,463	7,638	4,846	30,947	**18.5**
FPC Management	49,620	36,084	17,945	103,647	**61.7**
Total Black-tailed Deer Winter Range (%)	86,354 **(51.4)**	55,664 **(33.2)**	25,906 **(15.4)**	167,923 **(100)**	**100**

SOUTH PLAN AREA

Resource Management Regime (RMR) Category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
Existing Protected	78	1	0	79	**0.05**
Retention VQO	508	95	129	732	**0.5**
Partial Retention VQO	4,027	860	4,457	9,344	**5.8**
General Management	70,250	47,414	31,777	149,444	**93.6**
Total Black-tailed Deer Winter Range (%)	74,864 **(46.9)**	48,370 **(30.3)**	36,363 **(22.8)**	159,599 **(100)**	**100**

In the South Plan Area, 23% of the high suitability deer winter range occurs on the timber harvesting land base and is at potentially high risk from forest harvesting activities (Table 12). Although deer winter range requirements are partly addressed in the recent Strathcona TSA (1999), they do not cover Landscape Units within the Central Coast LCRMP boundary. Moreover, deer management guidelines are not addressed in the Kingcome portions of the plan area (TSR 1995). Therefore, there is no current forest cover constraint or other habitat management guideline that explicitly address deer winter range in the South plan area. Although inoperable areas can provide suitable winter range values, the deer winter range that occurs on the timber harvesting land base (23%) remains at risk. Those winter range areas that overlap retention and partial retention VQOs, however, are more likely to retain the winter range attributes (~13% of winter range in THLB) (Table 12).

Finally it should be noted that as for other ungulates (see moose, elk, mountain goat), designating deer winter ranges under the *Forest Practices Code* (FPC) as *Known Ungulate Winter Ranges* would further reduce the risks to deer habitat over the long term. The Bella Coola LRUP, for example, identified deer winter ranges that will be considered as *known ungulate winter ranges* under FPC.

18.6 6.5 Moose

18.6.1

18.6.2 6.5.1 Background

Although moose habitat and populations are limited over much of the plan area, moose populations have become established in discrete areas including the Kimsquit, Bella Coola and Kliniklini watersheds. In general, adequate quantities of forage and cover must be appropriately distributed over time and space to maintain moose habitat over the long term (a rotation), Because winter habitat is considered critical to maintain moose populations, maintaining adequate quantities of mature forest cover is also necessary. A desirable mix of forest seral stages to meet these requirements typically includes 30-40% mature forest and 30% early seral (shrubs and herbs available). In addition to these habitat requirements, road access must also be minimized and managed effectively to reduce the potential for over-hunting (i.e., increase hunter success) and poaching.

Specific assumptions used to estimate potential land use impacts on moose are outlined below (Table 13).

Table 13. Indicators and assumptions used to estimate potential impact of Resource Management Regimes (RMR) on Moose Habitat. Central Coast LCRMP - Base Case

Indicator	Assumptions

(1) Percent of moderate suitability moose winter range in each Resource Management Regime (RMR) category *(2) Percent of moderate suitability moose winter range that occurs in the timber harvesting land base.*	• Mature forests required for summer & winter thermal cover as well as security cover considered limiting. Travel routes between riparian areas considered fragmented over time. Increased road network considered a high risk. • FPC Management RMZs • Access management reduce risks to moose populations. Mix of seral stage distributions preferred.

18.6.3 6.5.2 Current Status and Anticipated Trends

Although there are relatively few moose found within the Central Coast LCRMP area, there are some landscape units that contain moderate (Class 3) winter habitat suitability. In the North plan area, a limited number of drainages totaling ~ 15,000 ha have been identified as moderate suitability moose winter range (Table 14). These areas include the riparian valley bottoms of the lower Kimsquit, Skowquiltz, Necleetsconnay, and Noeick Rivers as well riparian forests in the Kilbella/Chuckwalla and Clyak Landscape Units. In the South Plan Area, a similar total amount of moose winter range has been identified (~ 18, 000 ha) along the lower Klinaklini, Smokehouse and Seymour Landscape Units.

Because much of the moose winter range occurs in valley bottoms, a relatively high proportion of moose winter range falls within the timber harvesting land base. The GIS area analysis indicated 38% and 31% of moose winter range occurs on the THLB in the North and South plan areas respectively (Table 14). In the North, about 10% occurs in PAs and another 13% in Resource Management Regimes that would provide relatively low risk to winter habitat values (e.g., VQOs). In the South, less than 1% is in PAs and another 2.3% in VQOs.

Table 14. Areal breakdown of Moderate Suitability Moose Winter Range in each Resource Management Regime (RMR) category. Central Coast LCRMP – Base Case

NORTH PLAN AREA

Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
18.6.3.1.1.1.1.1 Deferrals	441	296	354	1,091	**2.8**
Existing Protected	2,977	900	60	3,925	**10.2**
Recreation Areas	0	0	0	0	**0.0**
Retention VQO	182	1,091	314	1,587	**4.1**
Partial Retention VQO	601	2,118	690	3,410	**8.9**
General Management	10,032	5,065	13,284	28,380	**73.9**
Total Moose Winter Range (%)	14,233 **(37.1)**	9,470 **(24.7)**	14,692 **(38.3)**	38,393 **(100.0)**	**100.0**

SOUTH PLAN AREA

Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMZ/LU BEO**
18.6.3.1.1.1.1.2 Existing Protected	49	2	0	51	**0.08**
Retention VQO	183	28	304	514	**0.8**
Partial Retention VQO	218	87	638	944	**1.5**
General Management	28,577	13,055	17,825	59,458	**97.5**
Total Moose Winter Range (%)	29,027 **(47.6)**	13,172 **(21.6)**	18,767 **(30.8)**	60,967 **(100.0)**	**100.0**

Overall, the allocation of moose winter range to the General FPC Management Regime (Table 14) suggests low to moderate risks (if they were applied as per Biodiversity Guidebook). That is, there is not a large percentage of moose winter range allocated to "high risk" management regimes in either the North (11%) or South (7%) plan areas. Once again, however, there appears to be little assurance that specific valley bottom ecosystems used by moose will be maintained over time. Although the management guidelines outlined for grizzly bear in the Central Coast TSR will partly contribute to the maintenance of winter moose range by maintaining some mature/old trees in valley bottom habitats, considerable uncertainty remains, particularly in the South plan area.

18.7 6.6 Mountain Goat

18.7.1 6.6.1 Background

Within the Central Coast LCRMP area, mountain goats inhabit rugged mountainous terrain from seal level to 2000 m elevation. High suitability areas have mature forest cover in close proximity to the steep south facing cliffs. Typically, mid and low elevation forests in the MH and CWH biogeoclimatic zones are used for foraging and shelter during the winter, but only where there is easy access (within 500 m) to escape terrain with rocky cliffs. Winter foods include conifers (yellow cedar, subalpine fir, hemlock, spruce), mosses and lichens.

Although mountain goats use alpine and subalpine habitats extensively (i.e., grassy alpine slopes, cliffs, avalanche chutes) forest harvesting and mining activities provide access into remote areas which increases the risks to local populations through increased legal and illegal hunting pressures. Mountain goats are also vulnerable to helicopter activity used for mineral exploration and development, commercial backcountry recreation (e.g., heli-skiing) and wildlife surveys. The potential impact these activities have on mountain goats, however, varies with the timing (season), frequency and duration of disturbance. Although some ungulate species may show a greater degree of habituation and tolerance to human-disturbance, mountain goats appear somewhat more susceptible to human disturbances (aircraft, helicopters, blasting) than other ungulates.

Indicators and assumptions used to estimate impacts of land use on mountain goats are shown in Table 15.

Table 15. Indicator and Assumptions used to estimate potential impact of Resource Management Regimes (RMR) categories on Mountain Goat Habitat – Central Coast LCRMP. Base Case

Indicator	Assumptions
(1) Percent of High suitability mountain goat winter range in each Resource Management Regime (RMR) category	• Increased road access poses moderate to very high risks to goat populations over the long term. • Forested areas near adjacent escape terrain (buffs. cliffs) considered limiting (thermal/security cover; kidding areas). • Protected Areas/Special Management preferred options to maintain goat population(s) due to reduced industrial disturbance/road networks. Connected areas are preferred to disjointed areas to maintain population linkages. • Mineral exploration/development and commercial recreation (e.g., heli-skiing) can increase risks to goat populations through disturbance and habitat displacement. Degree of impacts will vary with frequency and duration of activity. • Access management strategies or seasonal closures during resource development activities considered to partly reduce risks.

18.7.2 6.6.2 Current Status and Anticipated Trends

In the North plan area, the GIS analysis indicated 3% of mountain goat winter range occurs in Protected Areas and another 2.7% in Recreation Areas (Table 16). In contrast, no winter range is currently allocated to Protected Areas in the South plan area (Table 16). The relatively small amount of winter range that overlaps the timber harvesting land base (3-10%) in both plan areas, suggests direct conflicts with timber harvesting are minimal. Many of the forests used by goats occur in areas presently outside the timber harvesting land base. However, because mountain goats are known to use operable forests (if suitable escape terrain is nearby) these areas need to be further refined and managed appropriately.

Table 16. Areal breakdown of High Suitability Mountain Goat Winter Range in each Resource Management Regime (RMR) category. Central Coast LCRMP – Base Case

NORTH PLAN AREA

Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
Deferrals	1,821	10,771	153	12,744	**3.2**
Existing Protected	6,137	6,048	6	12,191	**3.0**
Recreation Areas	325	10,383	0	10,708	**2.7**
Retention VQO	2,672	5,123	285	8,081	**2.0**
Partial Retention VQO	5,002	14,385	610	19,997	**5.0**
General Management	82,728	242,095	12,397	349,618	**87.2**
Total Mountain Goat Winter Range (%)	98,685 **(24.6)**	288,805 **(72.0)**	13,451 **(3.4)**	400,941 **(100.0)**	**100.0**

SOUTH PLAN AREA					
Resource Management Regime (RMR) category	*Forested Exclusions (ha)*	*Non-forested Exclusions (ha)*	*Timber Harvesting Land Base (THLB) (ha)*	**Total Area (ha)**	**% of Total in each RMR category**
18.7.2.1.1.1.1.1 Existing Protected	3	0	0	3	**0.0**
Retention VQO	231	22	11	264	**0.001**
Partial Retention VQO	1,214	1,250	796	3,260	**1.2**
General Management	79,530	156,289	27,143	262,961	**98.7**
Total Mountain Goat Winter Range (%)	80,978 **(30.4)**	157,561 **(59.1)**	27,950 **(10.5)**	266,488 **(100.0)**	**100.0**

Although the total amount of overlap between the THLB and goat habitat is small, there is currently very little full protection provided for mountain goats. Therefore, the majority of mountain goat winter range is at risk from the potential indirect effects of increased road access into remote areas. Current management practices will help reduce the risks from resource development activities including mitigation techniques identified during mine development plans or the potential establishment of WHAs (e.g., kidding areas) as part of the IWMS. However, a comprehensive approach to maintaining mountain goat winter range is needed to reduce long term risks. Identifying and designating *Known Winter Ranges*, (FPC) and implementing effective access management strategies would substantially reduce these risks.

19.

20. 7.0 Karst Terrain

20.1.1 7.1 Background

Karst refers to any terrain where the topography has been formed predominately by the dissolving of bedrock-either carbonate(eg. limestone, dolomite, etc.) or non-carbonate(eg., evaporites-gypsum, anhydrite, salt, etc.). The development of karst terrain (ie. karstification) depends on the interaction of at least eight controlling factors: bedrock lithology, hydrogeology, bedrock structures, topography, climate, vegetation cover, time and glacial history. Carbonate bedrock is primarily susceptible to karstification because of its solubility. The best karst rocks occur in limestone with greater than 70 % calcium carbonate. Generally, the purer the limestone, the better the development of karst. Carbonates, of variable composition, make up approximately 10 % of the landscape surface of BC of which 80 % is limestone and 20% dolomite (reference - unpublished draft MOF document " Karst Inventory Standards and Procedures, March 1999).

The fundamental concept underlying the proposed karst inventory methodologies is that karst should be considered a system, as opposed to a collection of discrete surface features that may or may not be connected to subsurface openings or caves. Caves, considered one of the "highlights" of karst, are amenable to subsurface investigation and have been the past focus of the majority of karst inventories within BC. However, caves typically only make up a very small (eg. 0.01%) portion of a typical karst unit. The system approach recognises that karst operates as one holistic unit, whereby changes to conditions at the land surface can influence conditions below (eg. heavy rainfall at surface can lead to subsurface flooding). A karst ecosystem can be defined as a functional unit consisting of all living and non-living, physical and chemical elements of the karst environment that are linked through nutrient cycling and energy flow. The present description in this section focuses too much on karst features and not enough on the ecosystem approach.

Karst features such as caves not only provide denning and roosting areas for wildlife as well as recreational opportunities, but karst terrain in general supports highly productive ecosystems due to the combination of nutrient rich soils and good drainage. The soils that occur on these limestone substrates provide distinctive growing sites for trees, shrubs and plants. In addition, karst terrain also enhances the productivity of streams to support fisheries.

Karst features, however, are particularly vulnerable to environmental degradation due to logging and contamination of groundwater supplies from mining or waste disposal. Forest harvesting and road construction over karst terrain can potentially alter subsurface hydrological systems, infill caves and sinkholes with logging debris as well as increase sedimentation and soil erosion.

7.2 Current Status and Anticipated Trends

Initially completed for the Vancouver Forest Region in 1994 and the Prince Rupert Forest Region in 1995, karst reconnaissance level inventory has recently been updated (March 1999) and now covers the entire province at a scale of 1:250,000. This inventory level provides a coarse filter, in which terrain underlain by karstified bedrock is flagged and identified at a strategic level. It does not delineate specific cave/karst sites or features but qualitatively rates the terrain for potential karst-forming bedrock to occur and the intensity of karst development in a particular type of karst-forming bedrock based on geological mapping and known field occurrences.

For the Central Coast LCMRP, the likelihood or potential for karst-forming bedrock to occur and the intensity of karst development generally ranges from low to moderate with no areas showing any high or very high potential. There are known karst occurrences at Chapple Inlet on Princess Royal Island where recent forest development activities has uncovered fairly well developed epikarst and some karst features (shallow openings). The area covers 59.4 ha and has been classified as having moderate potential for karst development and intensity. The bedrock carbonate is a very pure form of limestone located less than 50 metres above sea level, which is considered fairly scarce along the BC Coast.

There are existing approved guidelines for cave management within the Vancouver Forest Region (1994). Interim karst management guidelines which have been drafted by the MOF (1999). They are still preliminary and have yet to be finalised and approved as a guidebook under the FPC.

There are few, if any, recognised karst features (eg. caves) that are considered significant within the Central Coast LCMRP area, especially when compared with the karst terrain and features of Vancouver Island (Strathcona TSA). It is recognised, however, that considerably more karst inventory at an operational level (1:50,000/1:20,000) is required within those areas identified at the reconnaissance level to ensure that any karst terrain that is sensitive or vulnerable to resource development activities is appropriately managed.

21.

22. 8.0 Conclusions

The information presented in this Base Case report suggests although some environmental values in the Central Coast LCRMP are receiving adequate management attention, certain wildlife species and many components of biodiversity (e.g., late successional forests, coarse woody debris) remain at high risk. This is largely due to the fact that many components of biodiversity require direction from higher level plans and/or landscape unit objectives, which are not in place. Although there are provisions in the Forest Practices Code to protect environmental values (e.g., ungulate winter range, wildlife habitat areas), these measures have yet to be integrated into most forest development plans[68]. Although the risks to environmental may decrease over time as these provisions are implemented, considerable uncertainty remains. Risks to biodiversity are also relatively high because current government policy as laid out in the LUPG is not consistent with the direction set out in the Biodiversity Guidebook (1995), which was designed to integrate all components of stand and landscape level biodiversity.

Because both biodiversity and timber values are not distributed evenly, varying degrees of risks also occur throughout the CCLCRMP plan area. Because some landscape units have very low timber values (e.g., due to operability) relative to others, these areas are at relatively less risk due to reduced human intervention. For these portions of the Plan Area, ecological processes will likely be more closely maintained by natural disturbances. As such, landscape units that contain a significant proportion of MH are likely to be at less risk whereas areas that have a high proportion of CWH are at higher risk. Overall, the risks to biodiversity appear to be somewhat greater in the South compared to the North plan area, due in part, to the larger timber harvesting land base (25-30% vs. 9%) and fewer forest management constraints integrated into the Timber Supply Review (TSR) processes. Moreover, because many of the landscape units in the South plan area have already undergone extensive forest harvesting further suggests, these landscape may be reaching critical thresholds for some organisms that have limited dispersal abilities or require large areas of contiguous forests (i.e. fragmentation effects).

In particular, coastal old growth ecosystems including Marbled Murrelet nesting habitat and grizzly bear habitat remain vulnerable to future resource development. This is largely due to concentrated forest development activity along valley bottoms, mitigation strategies that may provide inadequate protection (e.g., murrelet WHAs) and lack of management direction from a higher level plan, which is needed in particular, to address landscape level requirements for grizzly bears.

It is also certain that new road development will increase over time, which increases the risk to some species and habitat types. Although roads may be deactivated, the number of undeveloped watersheds will clearly decline. Because topographic constraints in the Central Coast LCRMP limit forest harvesting and road development to valley bottoms and lower slopes, these progressive linear developments will continue to reduce the availability of these highly productive ecosystems, which will result in increased risks to species and ecological processes dependent on them. This harvesting pattern combined with the proposed rate of harvest (TSRs) will result in significantly altered natural landscape structure and function of these coastal watersheds leaving little if any low elevation forest interior conditions with greatly diminished connectivity to upland areas.

It should also be emphasised that the risks to wildlife populations are also high because there is considerable *uncertainty* regarding the demographic consequences of increased resource development on most terrestrial vertebrate populations. The ability of each species to respond to disturbance and their ability to cope with a changing environment (i.e. resilience) also varies among species. We know, for example, that some species are more resilient than others, so the relative risks to these species are somewhat less than those that are less resilient (e.g., area or dispersal-limited species such as grizzly bears and tailed frogs). Furthermore, there is uncertainty related to the relative significance of habitat that lies within the timber harvesting land base to each species. Although converting mature and old forests to early seral conditions in a relatively short time frame (50 years) can only have significant negative effects on obligate old growth dependent species, it is less clear what impact this will have on species less dependent on valley bottom ecosystems. A reduction in some of the best nesting habitat for Marbled Murrelets (e.g., Sitka spruce forests in the CWH), for example, will result in significantly fewer murrelets (lower densities), however, the precise population or demographic effect is unclear.

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[68] Forest Practices Board. 1999. Annual Report.

Overall, the net result of the projected age class distributions and current management practices within the Central Coast LCRMP suggests species dependent on early seral forests will benefit the most whereas species dependent on old forest structures (wildlife trees, coarse woody debris) and/or large contiguous areas of old growth (forest interior conditions) remain at high risk in the short and long term. Significant management direction from a higher level plan needs to be developed during the Central Coast LCRMP process to adequately reduce these risks to acceptable levels. Some of the management recommendations set out in the *Silviculture Options Report* (Pojar *et al.* 1999) should be considered as ways of reducing risk to various components of biodiversity.

23.

24. 9.0 References

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25. 10.0 Appendices

25.1 Appendix 1.0 Terrestrial Wildlife Species at Risk in the Central Coast LCRMP area.

Provincial Ranking	Species	Risk Factors	Base Case Trend
Amphibian			
BLUE-LISTED (Identified Wildlife)	**Tailed Frog**	Habitat loss; disturbance around natal streams reduces water quality/flow regimes	FPC *Riparian Reserve Zones* will partly educe impact; species would benefit from wider buffers. IWMS may provide further protection by establishing WHAs along natal streams
Birds			
RED-LISTED (Identified Wildlife)	**Northern Goshawk (*laingi* sub species)**	Loss of mature and old forests (nesting habitat) due to forest harvesting.	Potential nesting habitat anticipated to decline over long term as mature and old growth forests are harvested. Identification and management of *Wildlife Habitat Areas* (i.e. *Managing Identified Wildlife Strategy*) may partly mitigate impacts; however input from **higher level plans** will be required to fully meet habitat requirements.
RED-LISTED (Identified Wildlife)	**Marbled Murrelet**	Loss of coastal old growth nesting habitat; fragmentation; marine pollution (e.g., oil spills)	Upper slope nesting habitat (i.e. MH subzones) at less risk due to inoperability. However, valley bottom (CWH) nesting habitat remains at high risk from forest harvesting due to inadequate habitat protection measures (i.e. OGMAs and *Wildlife Habitat Areas* proposed in *Managing Identified Wildlife Strategy*). Application of LUPG limits the options to fully address habitat requirements.
RED-LISTED	**Pelagic Cormorant**	Disturbance of roost sites; (shorelines; floodplains) marine pollution	Implementation of FPC Riparian Management Areas expected to reduce risk to roost sites and foraging areas
BLUE-LISTED	**Peregrine Falcon (Pealei)**	Forest harvesting, mineral development near nesting sites; environmental contaminants	Insufficient information

Provincial Ranking	Species	Risk Factors	Base Case Trend
BLUE-LISTED	**Short-eared Owl**	rare, loss of grassland meadows, estuaries, wetland habitat - fens; agricultural; residential development	Insufficient information
BLUE-LISTED (Identified Wildlife)	**American Bittern**	Loss of wetland habitat from agriculture/range activities	Reduced impact anticipated with implementation of FPC *Riparian Management Areas and Lakeshore Management Areas*. Potential establishment of *Wildlife Habitat Areas* (*Identified Wildlife Management Strategy*) may also reduce potential impacts.
BLUE-LISTED (Identified Wildlife)	**Sandhill Crane**	Loss of wetland areas for feeding, staging and breeding	Reduced impact anticipated with implementation of FPC *Riparian Management Areas and Lakeshore Management Areas*. WHAs (IWMS) may also reduce potential impacts.
BLUE-LISTED (Identified Wildlife)	**Trumpeter Swan**	Loss of wetland staging Areas; agricultural fields, estuaries provide winter habitat	Reduced impact anticipated with implementation of FPC *Riparian Management Areas and Lakeshore Management Areas*. WHAs (IWMS) may also reduce potential impacts.
BLUE-LISTED	**25.1.1.1.1.1.1.1.1 reat Blue Heron**	Loss of colony nesting habitat – heronies/ large trees with horizontal branching; Human disturbance during breeding season	FPR *Riparian Reserve and Management Zones* will reduce impact to nesting trees.
BLUE-LISTED	**Pine Grosbeak (*carlottae*)**	Habitat loss	Insufficient information
YELLOW-LISTED	**Bald Eagle**	Loss of nest/perching trees along riparian habitats	Reduced impact on nesting habitat due to wildlife tree retention and implementation of FPC *Riparian Management Areas and Lakeshore Management Areas*

Mammals

Provincial Ranking	Species	Risk Factors	Base Case Trend
RED-LISTED	**Northern Long-eared Myotis (Bat)**	Naturally rare, loss of wildlife trees used for maternal and day roosting trees/over-wintering hibernacula	Population status unknown Insufficient information

Provincial Ranking	Species	Risk Factors	Base Case Trend
BLUE-LISTED (Identified Wildlife)	**Grizzly Bear**	Loss of high quality seasonal habitats (e.g. estuaries, salmon spawning streams); altered seral stage distributions. Road access, fragmentation of habitat and populations, human settlement, poaching	Grizzly bears remain at high risks in the long term due to a decline in habitat suitability and increased road access from resource development activities. *Identified Wildlife Management Strategy* may partly reduce risks to specific habitat types by establishment of WHAs (e.g., avalanches chutes), however, input from *Higher Level Plan* (i.e., LCRMP) will be required to fully meet landscape-level habitat requirements.
BLUE-LISTED (Identified Wildlife)	**Fisher**	Loss of mature and old forests/riparian habitat. Fragmentation of riparian-upland habitats. Over trapping.	FPC *Riparian Management Areas* will provide partial protection for maternal denning sites; other habitats (resting, foraging) remains at moderate-high risk levels due to loss of mature and old forest stands (i.e., riparian-upland connectivity). *Forest Ecosystem Networks* may mitigate potential impacts. However, *HLP* landscape-level strategies are required to fully meet habitat requirements.
BLUE-LISTED	**Wolverine**	loss of large remote wilderness areas; vulnerable to over-harvesting (trapping)	Populations status unknown. Less remote wilderness areas and increased human disturbance in alpine habitats increases risks. Ability to adapt (resilience) unclear.
YELLOW-LISTED (Identified Wildlife)	**Mountain Goat**	Access development (logging roads, mining exploration trails and roads); human disturbance (e.g., helicopter, blasting), poaching, fragmentation	Establishment of potential WHAs (IWMS) near natal sites or escape terrain may reduce risks during mineral and forest development.

Freshwater Fish

Provincial Ranking	Species	Risk Factors	Base Case Trend
BLUE-LISTED (Identified Wildlife)	**Bull Trout**	Road development and stream channel disturbance. Migration barriers/habitat fragmentation	Reduced impact anticipated with implementation of FPC *Riparian Management Areas*, however, small streams in upper reaches remain vulnerable. WHAs may also reduce impact on spawning sites, however, landscape-level management will be required to reduce potential habitat and population fragmentation. Potential for decline in long term as more watersheds are roaded and developed.

Provincial Ranking	Species	Risk Factors	Base Case Trend

Rare Plant Communities			
Provincial Ranking	**Plant Community**	**Description/Risk**	**Base Case Trend**
25.1.1.1.1.1.1.1.2 **25.1.1.1.1.1.1.1.3** **25.1.1.1.1.1.1.1.4** **25.1.1.1.1.1.1.1.5 R** **ED-LISTED** **25.1.1.1.1.1.1.1.6** **25.1.1.1.1.1.1.1.7** **25.1.1.1.1.1.1.1.8**	*Sitka Spruce-Lily-of-the-Valley* **25.1.1.1.1.1.1.1.9 C** **WHvh1/08**	**Floodplain** forests on high fluvial benches/very productive	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.1.10 **.1.1.1.1.1.1.1.1**	*Sitka Spruce-Trisetum* **CWHvh1/09** **CWHvh2/09**	Middle fluvial bench **floodplain** forests	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.1.11 **.1.1.1.1.1.1.1.2**	*Amabilis Fir/Western Red Cedar-Foamflower* **25.1.1.1.1.1.1.1.12 C** **WHmm1/05**	Productive forests on lower slopes; lush herb layer	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.1.13 **.1.1.1.1.1.1.1.3**	*Amabilis Fir/Western Red Cedar-Salmonberry* **25.1.1.1.1.1.1.1.14 C** **WHmm1/07**	Very rich productive forests; well developed shrub and herb layers	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.1.15 **.1.1.1.1.1.1.1.4**	*Sitka Spruce-Salmonberry* **CWHvm1/09** **CWHws2/07** **CWHms2/07** **CWHxm2/08**	High bench **floodplain** forests dominated by Sitka Spruce and Western Hemlock	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	Western Red Cedar-Solomon's Seal **25.1.1.1.1.1.1.1.16 C** **WHds2/05**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	Western Red Cedar-Devil's Club **25.1.1.1.1.1.1.1.17 C** **WHds2/07**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	Western Hemlock/Cottonwood-Salmonberry **25.1.1.1.1.1.1.1.18 C** **WHds2/08**	High bench **floodplain** forests	At risk from forest harvesting; detailed mapping required to identify locations and distribution.

Provincial Ranking	Species	Risk Factors	Base Case Trend
	Douglas-fir-Sword Fern ***25.1.1.1.1.1.1.1.19* CWHxm2/04**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	25.1.1.1.1.1.1.1.20 Western Red Cedar-Salmonberry **25.1.1.1.1.1.1.1.21 CWHxm2/13** **25.1.1.1.1.1.1.1.22 CWHdm/13**	Highly productive **floodplain** forest with **strongly fluctuating water table**: Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	25.1.1.1.1.1.1.1.23 Western Red Cedar-Black Twinberry **25.1.1.1.1.1.1.1.24 CWHxm2/14** **25.1.1.1.1.1.1.1.25 CWHdm/14**	Highly productive **floodplain** forest with **strongly fluctuating water table**: Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
BLUE-LISTED	*Lodgepole pine/Yellow Cedar-Rhacomitrum* **CWHvh2/02**	Open forests that occur on dry exposed **rocky knolls** and **ridge crests**	Poor productivity sites; Likely places for WTPs reduces risks from forest harvesting
	25.1.1.1.1.1.1.1.26 Western Red Cedar/Sitka Spruce-Swordfern **25.1.1.1.1.1.1.1.27 CWHvh1/05** **CWHvh2/05**	Productive forests on steep slopes; Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.

Provincial Ranking	**Species**	**Risk Factors**	**Base Case Trend**
	25.1.1.1.1.1.1.1.28 W estern Red Cedar/Sitka Spruce-Devil's Club **CWHvh1/07** **25.1.1.1.1.1.1.1.29 C WHvh2/07**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	25.1.1.1.1.1.1.1.30 R ed Alder-False Lily-of-the-Valley **CWHvh1/10** **CWHvh2/10**	Low fluvial bench deciduous forests (**floodplain**) near streams and back channels/riparian	Partly captured in riparian reserve zones; detailed mapping required to identify locations and distribution.
	Sitka Spruce-Salal **25.1.1.1.1.1.1.1.31 C WHvh2/14**	**Shoreline forest** common on rocky headlands and beach plains. High value deer and elk foraging areas	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	Sitka Spruce-Reedgrass **25.1.1.1.1.1.1.1.32 C WHvh2/16**	**Shoreline forest** common on rocky headlands and old sand dunes: High value deer and elk foraging areas; potential Marbled Murrelet nesting sites	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	Sitka Spruce-Swordfern **25.1.1.1.1.1.1.1.33 C WHvh2/17**	**Shoreline forest** common on old marine terraces/moist sandy soils, very productive	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	Sitka Spruce-Slough Sedge **25.1.1.1.1.1.1.1.34 C WHvh1/18**	**Estuaries** and tidal sloughs; brackish water influence floral composition; High value habitat for deer, elk, bears, river otter	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
	Sitka Spruce-Crabapple **25.1.1.1.1.1.1.1.35 C WHvh2/19**	**25.1.1.1.1.1.1.1.36 pper estuaries**	

Provincial Ranking	Species	Risk Factors	Base Case Trend
25.1.1.1.1.1.1.1.37 LUE-LISTED	*Cottonwood-Red Osier Dogwood* **25.1.1.1.1.1.1.1.38 C WHvm1/10** **25.1.1.1.1.1.1.1.39 C WHws2/08** **25.1.1.1.1.1.1.1.40 C WHms2/08** **25.1.1.1.1.1.1.1.41 C WHds2/09**	Riparian **floodplain** forests (middle fluvial bench). High value deer, elk habitat. Perching trees for Bald Eagle	FPC *Riparian Reserves Zones* anticipated to capture portion of ecosystem; otherwise
25.1.1.1.1.1.1.2 2.1.1. 1.1.1.1.2	*Western Red Cedar/Western Hemlock-Swordfern* **25.1.1.1.1.1.1.2.1 C WHvm1/04** **CWHvm2/04** **CWHmm1/04**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.3 2.1.1. 1.1.1.1.3	*Western Hemlock/Lodgepole Pine-Cladina* **CWHvm1/02** ***25.1.1.1.1.1.1.3.1* C WHvm2/02**	Dry **bedrock outcrops** with high plant species diversity	
25.1.1.1.1.1.1.4 2.1.1. 1.1.1.1.4	*Western Hemlock/Western Red Cedar-Salal* **25.1.1.1.1.1.1.4.1 C WHvm1/03** **CWHvm2/03**	Need more information	Poor productivity reduces risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.5 2.1.1. 1.1.1.1.5	*Amabilis Fir/Western Red Cedar-Salmonberry* **CWHvm1/07** **CWHvm2/07**	High value Marbled Murrelet and tailed frog habitat	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.6 2.1.1. 1.1.1.1.6	*Amabilis Fir/Sitka Spruce-Devil's Club* **CWHvm1/08** **CWHvm2/08**	Gentle moderate receiving slopes; black bear and grizzly bear foraging/den sites; tailed frog habitat	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.7 2.1.1. 1.1.1.1.7	*Amabilis Fir/Western Red Cedar-Devil's Club* **CWHms2/06** **CWHws2/06**	Gentle moderate receiving slopes; black bear and grizzly bear foraging/den sites	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.8 2.1.1. 1.1.1.1.8	*Lodgepole Pine-Kinnikinnick* **25.1.1.1.1.1.1.8.1 C WHws2/02**	Rare confined to dry upper slopes and **ridge crests**. Widely spaced stunted pine forests.	Poor productivity; inoperable
25.1.1.1.1.1.1.9 2.1.1. 1.1.1.1.9	*Amabilis Fir/Western Red Cedar-Devil's Club* **CWHws2/06** **CWHms2/06**	Gentle moderate receiving slopes; black bear and grizzly bear foraging/den sites; tailed frog habitat	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.10 2.1.1.1. 1.1.1.10	*Lodgepole pine-Sphagnum* **25.1.1.1.1.1.1.10.1 C WHws2/10**	**Bog woodland** supporting scrubby pine and western red cedar.	

Provincial Ranking	**Species**	**Risk Factors**	**Base Case Trend**
25.1.1.1.1.1.1.11 2.1.1.1.1.1.11	*Western Hemlock/Amabilis Fir-Step Moss* **25.1.1.1.1.1.1.11.1 C WHms2/01**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.12 2.1.1.1.1.1.12	*Amabilis Fir/Western Red Cedar-Oak Fern* *25.1.1.1.1.1.1.13 CWHms2 /04* **25.1.1.1.1.1.1.13.1 C WHws2/04**	Middle to lower slope seepage areas.	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.14 2.1.1.1.1.1.13	*Douglas Fir-Western Hemlock-Falsebox* **25.1.1.1.1.1.1.14.1 C WHms2/03** **CWHds2/03**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.15	*25.1.1.1.1.1.1.15.1 W estern Hemlock/Amabilis Fir-Pipecleaner Moss* **25.1.1.1.1.1.1.15.2 C WHmm1/01**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.16	*25.1.1.1.1.1.1.16.1 D ouglas-fir-Western Hemlock-Salal* **25.1.1.1.1.1.1.16.2 C WHmm1/02**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.17	*Western Hemlock/Western Red Cedar-Salal* **25.1.1.1.1.1.1.17.1 C WHmm1/03**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.18	*Cottonwood-Willow-Thimbleberry* **25.1.1.1.1.1.1.18.1 C WHms2/09**	Low bench **floodplain forests**; Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.19	*Western Hemlock/Douglas Fir-Electrified Cats-Tail Moss* **25.1.1.1.1.1.1.19.1 C WHds2/01**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.

Provincial Ranking	Species	Risk Factors	Base Case Trend
25.1.1.1.1.1.1.20	*Douglas-Fir/Lodgepole Pine-Kinnikinnick* **25.1.1.1.1.1.1.20.1 C WHds2/02**	Very dry nutrient poor sites;	Poor productivity reduces risk from forest harvesting
25.1.1.1.1.1.1.21 *25.1.1.1.1.1.1.22* *25.1.1.1.1.1.1.23* *25.1.1.1.1.1.1.24* *25.1.1.1.1.1.1.25* *25.1.1.1.1.1.1.26* *25.1.1.1.1.1.1.27*	*Cottonwood-Willow* **CWHds2/04**	Riparian **floodplain forests** (low fluvial bench)	Hygric (very wet) soil conditions makes this community less vulnerable to forest harvesting and generally left as wildlife habitat. Should harvesting occur, FPC *Riparian Management Areas* (wetlands and bogs) and *Wildlife Tree Patches* (WTPs) may identify and reduce impacts during preparation of forest development plans.
25.1.1.1.1.1.1.28	*Western Hemlock-Queen's Cup* **25.1.1.1.1.1.1.28.1 C WHds2/06**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.29	*Douglas-fir-Douglas Maple-Fairybells* **25.1.1.1.1.1.1.29.1 C WHds2/10**	Dry ridges, steep south facing slopes	
25.1.1.1.1.1.1.30 2.1.1 .1.1.1.1.14	*Western Hemlock/Douglas Fir-Kindbergia* **25.1.1.1.1.1.1.30.1 C WHxm2/01**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.31 2.1.1 .1.1.1.1.15	*Douglas Fir-Western Hemlock-Salal* **25.1.1.1.1.1.1.31.1 C WHxm2/03**	Need more information	
25.1.1.1.1.1.1.32 2.1.1 .1.1.1.1.16	*Western Red Cedar-Swordfern* **25.1.1.1.1.1.1.32.1 C WHxm2/05**	Need more information	
25.1.1.1.1.1.1.33 2.1.1 .1.1.1.1.17	*Western Hemlock/Western Red Cedar-Deer Fern* **CWHxm2/06** **25.1.1.1.1.1.1.33.1 C WHdm/06**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.
25.1.1.1.1.1.1.34 2.1.1 .1.1.1.1.18	*Western Red Cedar-Foamflower* **25.1.1.1.1.1.1.34.1 C WHxm2/07**	Need more information	At risk from forest harvesting; detailed mapping required to identify locations and distribution.

Provincial Ranking	Species	Risk Factors	Base Case Trend
25.1.1.1.1.1.1.35 2.1.1.1.1.1.1.19	*25.1.1.1.1.1.1.35.1 Cottonwood-Willow* **25.1.1.1.1.1.1.35.2 C WHxm2/10**	Need more information	
25.1.1.1.1.1.1.36 2.1.1.1.1.1.1.20	*25.1.1.1.1.1.1.36.1 Lodgepole Pine-Sphagnum* **25.1.1.1.1.1.1.36.2 C HWxm2/11**	Need more information	
25.1.1.1.1.1.1.37 2.1.1.1.1.1.1.21	*25.1.1.1.1.1.1.37.1 Western Red Cedar-Slough Sedge* **25.1.1.1.1.1.1.37.2 C WHxm2/15** **25.1.1.1.1.1.1.37.3 C WHdm/15**	**Estuaries and tidal sloughs**; brackish water influence floral composition; High value habitat for deer, elk, bears, river otter	

25.2 Appendix 2.0 Habitat suitability mapping for key wildlife species in the CCLCRMP.

Central Coast
Land and Coastal Resource Management Plan

Base Case

Part 3

Environmental – Marine

25.2.1.1.1.1.1.1 Prepared by

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Part 3 Summary Matrix: Marine Resources Base Case

Marine Resource Account: Non-anadromous Fisheries - Base Case Trends	
Coastal Marine Habitats	• Habitats with high ecological significance in the Plan Area include salt marshes, sea grass beds, tidal flats, canopy kelp beds, subtidal rock reefs and localized upwelling areas. Systematic mapping of these habitats was not available for the base case analysis. • These habitats may be affected by physical disturbances to the bottom structure, changes in water quality and activities that alter nearshore sedimentation and littoral drift patterns. • Salt marshes, sea grass bed and tidal flats are often associated with estuaries at the head of the mainland inlets. Estuaries are frequently selected as areas for log dumps and storage and docking facilities within the Plan Area. These activities have been shown elsewhere to have localized impact on the habitat. • Subtidal rock reefs are most common along the outer coast of Queen Charlotte Sound. They are currently most vulnerable to impacts from commercial bottom trawling. • Canopy kelp beds are most abundant in planning units 5 (Hakai), 13 (Malcolm Is, N. Vancouver Is., Estevan Group), 10 and 15. The main causes of mortality are winter storms and grazing by herbivorous marine invertebrates such as urchins.
Urchins	• Red, green and purple sea urchins occur in the Plan Area but only red and green are commercially fished. • In the southern Plan Area (south of Cape Caution) green sea urchins are now relatively abundant with good recruitment. There is limited information for other areas and species and fishery management is precautionary. • Otters will and are having an impact on sea urchin abundance. The long-term trend in some areas of the Central Coast is likely a decline in urchin abundance and an increase in otter abundance.
Sea cucumbers	• There are several sea cucumber species present but only Parastichopus californicus is fished commercially. • There is no information on the size or trend of sea cucumber populations in the Plan Area. • Parastichopus californicus is sedentary except for a brief planktonic larval period and populations are probably local.
Crabs	• There are over 80 species of crab found in BC waters however only one species the Dungeness crab (Cancer magister), is targeted by a substantial commercial fishery. Recreational fishers also take the red rock crab (C. productus). • There are no large commercial fishing areas within the Plan Area for Dungeness crab, probably due to the lack of suitable habitat. Small areas are located in most planning units. • Juvenile Dungeness crabs concentrate in coastal and are effected by human activities such as log storage and dumping which tend to be concentrated in those locations. • There is a possible threat to crab populations from the green crab that has recently been found in BC waters.
Shrimps/ prawns	• There are over 87 species of shrimp and prawns found in BC waters, seven species in sufficient numbers to support several small commercial and recreational trap and trawl fisheries. • The stock status of shrimp species is poorly known however assessment programs have recently been initiated.. • Most prawn stocks on the coast are thought to be healthy but fully exploited to the point where the minimum escapement is occurring in most populations of the region. • Commercial fishing has the most influence on the shrimp stocks. Coastal log storage and handling may negatively effect nearshore species and life stages. • Bycatch of other species (e.g. eulachon) by the shrimp trawl fishery is of concern.
Intertidal clams	• Four species of intertidal clam are harvested in British Columbia, the manila (Venerupis philipinaarum), littleneck (Protothaca staminea), butter (Saxidomus giganteus) and razor clam (Silqua patula). • There is no information on the status and trends of North Coast intertidal clam populations. Clams have been harvested for thousands of years in the region as demonstrated by the numerous middens found there. • The Manila clam is an introduced species and are less abundant in the Plan Area than the littleneck and butter clam species. The razor clam is uncommon in the Plan Area. • It is unlikely that clam beds in the northern Plan Area have been overfished due to long term closures by DFO. There is a growing interest in developing intertidal clam fisheries in North Coast areas. • Clam fisheries are susceptible to nearshore and backshore human activities that result in siltation or changes in the sediment regime of the clam beaches (e.g. foreshore structures, log handling). There is a potential threat to populations from predation by the Green crab recently found in BC waters.

Marine Resource Account: Non-anadromous Fisheries (cont.) - Base Case	
Geoduck	• There is no information on the current status of geoduck populations in the Plan Area. • The management practice for geoducks is conservative and designed to ensure long-term viability of the

	resource. • Human activities, other than fishing, that could affect geoduck populations would be activities that change the composition or chemistry of the bottom substrate (e.g. log handling, aquaculture, sewage disposal, siltation from backshore logging, ocean dumping or dredging).
Abalone	• The northern abalone is currently on the Committee on the Status of Endangered Wildlife in Canada's (COSEWIC) list of endangered species. • Because of overfishing, the fishery for abalone was closed to all user groups in 1990. The stock continues to decline from 1993 to 1997 probably due to poaching. • The long-term trend for abalone stocks in the Plan Area may be one of improvement as DFO is moving towards implementation of a stock re-building initiative.
Octopus	• Although there are possibly nine species of octopus in BC only the giant Pacific octopus (Octopus dofleini) is commercially fished. Most of the fishery has taken place on the south coast of BC, outside of the Plan Area. O. rubescens is caught as a bycatch in the shrimp trawl fishery. • There are no estimates of the absolute abundance or trends of octopus populations in the Plan Area. • Octopus is a frequent by-catch in crab and prawn trap and in groundfish and shrimp trawl fisheries. Human activities that reduce the availability of dens (e.g. bottom trawling) may increase mortality by increasing competition for den sites.
Herring	• Pacific herring (Clupea pallasi) are commercially fished primarily for their roe. They are also an essential component in the complex coastal food web. • Since 1988, the pre-fishery biomass has fluctuated at levels above 20,000 t. It reached near historic levels of over 50,000 t in 1992, declined between 1992 and 1996 and then increased to 39,000 t in 1998 with a forecast for 43,400 t in 1999. The recent increase is thought to be due to strong recruitment of the 1994 and 1995 year-classes. • Herring spawn is most extensive and dense in Planning Units 2, 5, and 6. The most significant area of spawn in the planning area is in Kitaso Bay in Planning Unit 2. • Any human activity that alters the composition of macrophytes used for spawning substrate would affect herring. Guidelines and regulations currently prohibit destructive fishing (e.g. for geoducks), aquaculture and log handling activities in areas of vital, major or important herring spawn. • Herring have been ranked at least 10 times more susceptible to oil spills than groundfish and other non-salmonids.
Pilchard	• The northern pilchard stock supported a major fishery in the early 1900's, peaked in the 1930s, decreased in the 1940's and collapsed in the early 1950's. The current interpretation of the collapse of northern stock is that overfishing exacerbated a decline caused by environmental change. In 1979, the northern stock showed the first signs of recovery. Reports from the past two years indicate that the stock is continuing to increase. The BC stock was designated a "vulnerable" species in 1987. • An experimental fishery for pilchards was begun in 1995.
Smelt	• There are two species of fish classed as smelt in BC, the surf smelt (Hypomesus pretiosus prestiosus) and the longfin smelt (Spirinchus thaleichthys). Populations in the Plan Area have not been monitored and their abundance and distribution in the region is not known. • There are no commercial fisheries for smelt within the Plan Area although aboriginal fisheries may occur. • Human activities that destroy the habitat at spawning locations could have impacts on local populations.
Sandlance	• Sandlance (Ammodytes hexapterus) is well documented as an important food for many species of marine birds, mammals and commercial fish. • The distribution and abundance of sandlance is poorly known in the Plan Area. Evidence suggests that its abundance fluctuates substantially from year to year. • Sandlance are not commercially fished in BC except for a small bait fishery. Human activities that destroy the nearshore sand habitat where the sandlance burrow could affect local populations.
Rockfish	• There are at least 35 species of Sebastes or "rockfish" found in BC coastal waters. For management purposes, they are divided up into "inshore", "shelf" and "slope" species. • Rockfish species are long lived with low rates of production. Stocks once depleted will be slow to rebuild. Occasional "spikes" of high recruitment have been recorded but are not frequent.. • Catch is not thought to be a good indicator of abundance for any rockfish species. • Inshore rockfish are dominated by yelloweye, quillback and copper rockfish species. There is too little information to determine the stock status of inshore rockfish species in the region. (continued next page)

Marine Resource Account: Non-anadromous Fisheries (cont.) - Base Case	
Rockfish, continued	• Shelf rockfish species are dominated by yellowtail, silvergray, widow and canary rockfish. The yellowtail stock in the Plan Area is declining, probably due to poor recruitment exacerbated by fishing. Silvergray and canary rockfish may also be declining but there is insufficient data to substantiate this. • Slope rockfish species include Pacific ocean perch, yellowmouth, redstripe, rougheye and shortraker rockfish and shortspine and longspine thornyheads. There is little evidence of stock depletion, except for longspine thornyheads. • Rockfish species are highly susceptible to over-fishing, especially in localized areas. The trawl fleet is increasingly moving onto rocky substrates and could possibly have impacts on the habitat of the species it is fishing.
Pacific halibut	• Pacific halibut (Hippoglossus stenolepis) were subject to overfishing at the beginning of the 20th century. Overfishing stopped in 1923 with the establishment of the International Pacific Halibut Commission. Since the climate regime shift of 1976-77 in the North Pacific, the recruitment rate of Pacific halibut increased dramatically in both British Columbia and Alaska. Concurrently, however, the growth of individual halibut has decreased dramatically in Alaska and to a lesser extent in British Columbia. • Pacific halibut first appear in British Columbia waters at age four years and older and so the younger, more sensitive life history stages are not found in the Central Coast Plan Area. • The most significant local impacts on the halibut stocks, apart from directed, come from by-catch of halibut by vessels fishing for other species.
Flatfish	• In addition to Pacific halibut there are fifteen species of flatfish commercially fished or caught as bycatch in other trawl fisheries in BC waters including Starry flounder, Arrowtooth flounder, Dover sole, Butter sole, Flathead sole, Slender sole, Curlfin sole, Rex sole, Sand sole, English sole, Petrale sole, Speckled sanddab, Pacific sanddab, C-O sole, Rock sole. • There is little information on the current status and trends for most species of flatfish in the region. The three stocks for which there is information on the stock status (West Coast Queen Charlotte Islands / Hecate Strait Dover sole, English sole and rock sole) are all currently declining. The English and rock sole stocks are around the long-term average abundance while that of the Dover sole stock is low. • Flatfish species with pelagic eggs are most vulnerable to impacts from oil spills. Some species, at one or more life stages, are associated with nearshore habitats during such as estuaries, eelgrass beds or kelp beds and may be affected by human activities in these areas.
Walleye pollock	• Walleye pollock (Theragra chalcogramma) is the most abundant fish species in the North Pacific Ocean. There is not enough biological information to determine the current status of this stock. • Human activities other than commercial fishing are unlikely to impact on the walleye pollock population within the Plan Area.
Pacific cod	• Pacific cod (Gadus macrocephalus) are a short-lived, reasonably fecund species with constant fluctuations in the stock size due to environmental influences.
Offshore Pacific hake	• Offshore Pacific hake (Merluccius productus) are migratory fish that range from southern California to Queen Charlotte Sound. Coastwide the species is treated as two stocks; the stock found in the Plan Area is thought to be at moderate abundance having steadily declined from a record high abundance in 1986. There were no strong year classes during the 1990s and recruitment to the fishery over the next few years is expected to be low as a result. • Pacific hake does not breed in the Plan Area and its population is located primarily offshore of the Plan Area boundaries. Human activities within the Plan Area are expected to have little effect on Pacific hake.
Offshore lingcod	• The Lingcod (Ophiodon elongatus) stock in Queen Charlotte Sound has undergone marked fluctuations in abundance since monitoring began in 1956. The stock appears to have been declining since the late 1980s and in 1995 the CPUE was the lowest it has been since 1973. • There is very limited recruitment from other neighboring stocks and that it is important to protect local stocks from over-fishing or habitat loss.
Sablefish	• Coastwide in BC sablefish (Anoplopoma fimbria) is genetically one stock but managed as two stocks – a southern stock and a northern stock with the dividing line around Queen Charlotte Sound. Catch has been reasonably stable over the last 30 years. • The species are long lived and mostly non-migratory. Establishment of new stocks and genetic exchange is by movement of the juveniles and young adults. • Adult sablefish are mostly found at depths of 600-800 m along the continental slope. Some Central Coast inlets have an abundance of young (3-4 years) sablefish. • The main cause of mortality other then from the directed fishery is from by-catch in the hook and line fisheries. The species could be locally affected by disposal of mine tailings in mainland inlets.

Marine Resource Account: Birds - Base Case Trends	
Marbeled Murrelet	• The Marbled Murrelet was listed as an endangered species in Canada in 1990 mainly because of loss of nesting habitat, but also because of fishing-net mortality and the threat of oil spills. • Available evidence indicates that the population of Marbled Murrelets has declined and will continue to decline over most of its range. It is estimated that 16-17% of the North American Marbled murrelets are in British Columbia. • The management of marine habitats to reduce risks of mortality from human sources is felt to be of equal importance to the management of terrestrial environments to maintain nesting habitat. • Main causes of mortality include entanglement in fishing nets, capture by sport fishing gear and fouling by oil spills.
Colonial Alcids	• 80% of the world population of Cassin's auklets nest in British Columbia. About 1% of the BC population nests on the Buckle group at the entrance to Queen Charlotte Strait (Planning Unit 13). Cassin's Auklet is blue-listed provincially. • 57% of the world population of Rhinoceros auklets nest in British Columbia. About 72% of the BC population nests on Pine and Storm Islands at the entrance to Queen Charlotte Strait. Populations of Rhinoceros auklets in British Columbia are thought to be increasing at present. • It is estimated that about 9,382 Pigeon guillemots breed at 310 sites along the BC coast within the Plan Area there are an estimated 1,648 pairs of Pigeon guillemots at 32 known sites. There is no information on trends for this species • Colonial alcid species are high vulnerable to oil pollution. • All colonial alcid species are very sensitive to disturbance during the nesting period and vulnerable to introduced predators such as rats and racoons.
Storm Petrels	• Storm pertrels currently nest at six locations within the planning unit 13 in the southern Plan Area. All six nesting sites are within the Duke of Edinburgh Ecological Reserve where 32% and 50% of the British Columbia population of Fork–tailed Storm Petrels and Leach's Storm Petrel respectively are located. There is no information for trends of these species. • Eco-tourism poses a potentially significant threat to storm petrels if uneducated tourists come ashore on islands supporting colonies. Extremely unfavorable weather conditions or insufficient food may also cause petrels to temporarily abandon their nests resulting in reduced viability of eggs or death of chicks. Predators pose a threat to storm petrels on their colonies. Storm petrels are most vulnerable to oil pollution during the summer months.
Albatrosses, Fulmars and Shearwaters	• Black-footed Albatross, Northern Fulmar, Sooty Shearwater, Short-tailed Shearwater, Pink-footed Shearwater, and Buller's Shearwater are all migrants passing through the Plan Area. None of these species breed in the region and their status in the region is unknown. • Threats to these species include marine debris, entanglement in fishing gear, and competition with commercial fisheries for pelagic fish.
Glaucous-winged gull	• About 6.4% of the BC population of Glaucous-winged gulls nests within the Plan Area in planning units 5, 10, 13 and 15. The largest colony is located on Major Brown Rock. Populations of Glaucous-winged gulls in British Columbia are thought to be increasing at present due to the increasing supply of food from human refuse. • Glaucous-winged gulls are very sensitive to disturbance during the nesting period.
Coastal gull species	• Bonaparte's gull and Mew gulls migrate through nearshore regions of the Plan Area. They are less vulnerable to oil spills of disturbance than other species.
Offshore Laridae	• Pomarine Jaeger, Parasitic Jaeger, Herring Gull, Thayer's Gull, California Gull, Black-legged Kittiwake, Sabine's Gull, and Arctic Tern may form feeding concentrations in two regions of the Plan Area; at the entrance to Queen Charlotte Strait over Cook Bank along the north shore of Vancouver Island (Planning Unit 13), and over the Goose Bank (outer portion of Planning Unit 4). • Threats to these species include marine debris, entanglement in fishing gear, and competition with commercial fisheries for pelagic fish.
Black oystercatcher	• Within the Plan Area there are an estimated 91 breeding pairs of Black oystercatcher at 34 sites; about 9.1% of the BC population. Nest sites are concentrated in planning unit 13 with additional sites in planning units 5 and 10. • The Black Oystercatcher is highly vulnerable to disturbance while breeding.

Marine Resource Account: Birds (cont.) - Base Case Trends	
Other shorebirds	• Most shorebirds are migrants or winter visitors to the coastal portions of the planning area. Those individuals that do reside in the planning area are at the periphery of their range. Estimation of the population and trends of species other than Black Oystercatchers was not attempted due to lack of data. • The sites used by migratory shorebirds are concentrated along the outer coast areas that protrude into Queen Charlotte Sound (primarily Planning Units 5 and 10). An increase in human use at these sites could impact the use by shorebirds.
Pelagic Cormorant	• The Pelagic Cormorant is the only cormorant species to breed in the Central Coast Plan Area. There are four colony sites within the Plan Area with a total of 47 breeding pairs. The pelagicus subspecies is red-listed provincially. • The pelagic cormorant is vulnerable to disturbance while nesting. They have been reported as a by-catch in commercial fisheries and are highly vulnerable to oil spills.
Other cormorants	• The Double-crested cormorant is rare in the Plan Area. Brandt's cormorant is a migrant along the outer coast of the Plan Area. The population of Brandt's cormorant in BC has decreased recently, but numbers are known to fluctuate greatly from year to year. Brandt's Cormorant is red-listed provincially
Divers (loons and grebes)	• Three loon and three grebe species may be found but do not breed in the marine waters of the Plan Area. • Human use of sheltered bays and estuaries may displace these species.
Waterfowl (geese, swans, ducks)	• Trumpeter swans, Canada geese, Brant, four species of dabbling ducks and eleven species of diving ducks frequent the Plan Area. There are no major waterfowl breeding grounds within the Plan Area. Most species either migrate through the region or overwinter there. • Over 60% of the world's population of Barrow's goldeneye and Surf scoter overwinter in BC coastal waters. The Surf scoter is blue-listed provincially. • Harlequin Ducks, Surf Scoters and White-winged Scoters may move to marine waters during the late summer (July-August) to areas with high food abundance during the post-breeding moult. • Almost the entire world's population of Brant migrates along the BC coast each spring, resting to feed on eelgrass in muddy tidal flats. The population of Brant has declined dramatically over the last 100 years and although the numbers have remained stable over the past 30 years, fewer birds are migrating as far north as the Plan Area. • The Trumpeter swan is on the provincial blue-list because of over harvesting in the 19th and early 20th centuries. • Hunting is a major component of waterfowl mortality but is well regulated. Alienation of prime habitat such as eelgrass beds and salt marshes can impact waterfowl use.

Marine Resource Account: Mammals - Base Case Trends	
Harbour seal	• Harbour seals are by far the most abundant marine mammals in BC coastal waters. Subsequent to heavy culling up to the 1970's, the British Columbia population is estimated to have increased at a rate of about 11.9% per annum during the 1970's and 1980's, 7.2% in the mid-1990s and currently it is close to 0%. The current BC population is estimated at 124,000 harbour seals. • Harbour seals are non-migratory and tend to show high site fidelity to specific haulout sites. Most areas of the Plan Area have not been surveyed to locate haul out sites. • Shooting of seals by commercial fishers and salmon farm operators may significantly reduce local populations but should have little effect on the population coastwide. • Adult harbour seals have a relatively low sensitivity to the effects of an oil spill. Harbour seal pups are probably more sensitive.
Sea lions	• California sea lions have become relatively common in the southern portion of the Plan Area since 1998, possibly as a response to changes in pelagic fish populations. They do not breed in the Plan Area which is at the northern edge of their range. • Steller sea lions in BC were culled between 1913 and 1968. During that time the population was reduced by half to a level of about 5-6,000 animals. The population has been slow to recover and currently has a growth rate of about 1-3% per annum. Populations in Alaska are declining sharply possibly due to reduction in their prey (mackerel and pollock) and are currently listed as endangered. • Steller sea lions breed on 5 large breeding colonies on the western edges of the Plan Area. Post-breeding the sea lions move to traditional haulout sites on offshore islands in Queen Charlotte Sound and outer Queen Charlotte Strait (planning units 4, 5, 10 and 13). • Harassment and shooting of sea lions by commercial fishers and salmon farm operators may have some impact on the population but the extent is not known. • Adult sea lions have a relatively low sensitivity to the effects of an oil spill. Sea lion pups are probably more sensitive but are not found in the Plan Area.
Killer whale	• There are three distinct communities of killer whales that occur in the Central Coast planning area: northern resident, transient and offshore. All three communities are currently on the provincial blue-list. • Two beaches in planning unit 13 are know to be used as "rubbing" beaches by resident killer whales. These appear to be important to the community and are vulnerable to disturbance by human presence. • Harassment of whales by ecotourism is of concern.. • Noise pollution from vessel traffic and acoustic deterrent devices used at salmon farm operations may disturb whales and interfere with echolocation and communication. • Oil spills would likely have to be on a large scale in a confined space (as the Valdez spill was) to cause mortality of killer whales. High levels of organochlorines and heavy metals have been measured in the tissues of both resident and transient killer whales in BC.
Gray whale	• The north-east Pacific population of Grey whales was hunted to near extinction in the 19th century, received protection from coast whaling in 1937 and has subsequently recovered to pre-exploitation levels. The 1997/98 population size was estimated to be 26,635 whales. As a result of the successful recovery of this population, Grey whales have been removed from the endangered species list. • Almost the entire north-east Pacific population of Gray whales migrates along the outer coast of BC on route from winter breeding grounds in Baja California to summer feeding grounds the Beaufort and Chukchi Seas. There are probably about 150 resident animals that do not migrate further north but remain in BC between March and November. The number that remain in the Plan Area is unknown. They are most commonly sighted in planning unit 13. • Grey whales are more vulnerable than other whales to impacts of catastrophic oil spills. Collisions with boats and entanglement in fishing gear have been reported.
Humpback whale	• All stocks were heavily exploited in the 19th and early 20th centuries. After 1965, humpback whales were protected from whaling but recovery of the population has been slow. The North Pacific humpback whale stock was assigned "Threatened Status" in 1982. It is estimated that by 1965, the North Pacific stock had been reduced to 850 animals from a pre-exploitation level of 15,000. The most recent population estimate is 8,000 animals in the North Pacific. • Entanglement in fishing gear is a significant problem for Gray whales. • Noise pollution from vessel traffic and acoustic deterrent devices used at salmon farm operations may disturb whales and interfere with echolocation and communication

Marine Resource Account: Mammals (cont.) - Base Case Trends	
Pacific white-sided dolphin	• There are no reliable estimates of the population of Pacific white-sided dolphin in the North Pacific, although it is generally believed to be one of the most abundant species. Estimates range from 50,000 to over 6 million. The population is thought to be stable. • The distribution of Pacific white-sided dolphin in the Plan Area has changed dramatically over the last ten years, becoming much more common in certain locations. It is not yet known if this is a temporary or long-term change in distribution. • Entanglement in high seas flying squid driftnet fisheries has been a significant cause of mortality in the North Pacific. There are reports of Pacific white-sided dolphin entangled in coastal salmon nets however the mortality rate is not known.
Dall's porpoise	• There are no estimates for the size of the Dall's porpoise population in the eastern North Pacific, although it is estimated that 1.4 to 2.8 million occur throughout the entire North Pacific and Bering Sea. • There are reports of Dall's porpoises entangled in coastal salmon nets however the mortality rate is not known.
Harbour porpoise	• There are no surveys of harbour porpoise in the Plan Area. It is thought that BC waters might support a population of 15-20,000 harbour porpoise coastwide. Harbour porpoise are known to have declined in some parts of their range. The harbour porpoise is in the provincial blue-list. • There are reports of Dall's porpoises entangled in coastal salmon nets however the mortality rate is not known. • Noise pollution from vessel traffic and acoustic deterrent devices used at salmon farm operations appears to disturb Dall's porpoises and may interfere with echolocation and communication. • Chemical contamination has been identified as a problem in Washington State.
Sea otter	• By 1911 the British Columbia population had been extirpated due to hunting. The population is recovering and the growth rate of the population is estimated to be 18-20% (a doubling time of about 4 years). In 1995 a minimum of 1522 sea otters were found in BC and the world-wide population is thought to be about 150,000 animals. About 135 sea otters are found in the Plan Area around the Goose Group in planning unit 5. • The greatest threat to sea otters is from oil spills. Sea otters are sensitive to human disturbance from human activities e(.g. ecotourism), particularly females with pups. Other human-related threats to sea otters include local concentrations of environmental toxins, conflicts with shellfish fisheries and incidental entanglement in net fisheries.
Other cetaceans	• Blue, minke, fin, sei, sperm and northern right whales were all hunted commercially in BC waters between 1905 and 1967. None of these species appear to have recovered from this exploitation and all are presently uncommon in the region.

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26. 1.0 INTRODUCTION

The Land and Coastal Resource Management Plan (CCLCRMP) for the Central Coast planning area is a comprehensive plan for areas under federal and provincial management regimes. The planning process seeks to find consensus between the stakeholders on the best use of areas and resources. One of the first steps in the planning process is to try to provide all stakeholders with a common knowledge base of the marine and coastal area. The key objective of this report is to provide an overview of the biological marine and coastal resources in the Central Coast CCLCRMP area. This analysis is referred to as the Marine Environmental "Base Case". A second objective of the report is to describe the impacts of human use or activities on the marine resources that are found there in the absence of a land use plan, (i.e., in the 'Base Case' scenario). For planning purposes, the analysis of the distribution of all marine environmental features in this section has been done with respect to the 16 *Marine Planning Units* defined for the purpose of the LCRMP (BC Land Use Coordination Office and the Ministry of Fisheries 1998).

This document is meant to act as a Base Case analysis and to initiate discussion by the stakeholders. At the initiation of the base case there had been little input by stakeholders on what constitutes key environmental values. Stakeholders include a diverse group of people including First Nations[69] and other community representatives, representatives of the various resource harvest industries (primarily fishing and forestry) and representatives of the tourism and aquaculture industries which appear poised to expand in the area. Both the provincial and federal governments are involved in the planning process.

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[69] While First Nations have been recognised as a level of government in the LCRMP process but at present do not have a management regime to the same extent as the federal and provincial government..

27. 2.0 SCOPE AND LIMITATIONS

The marine environmental "features" included in the marine base case include marine habitats and marine species or groups of similar marine species. The features that have been included in the marine base case reflect both the environmental significance of the features and the amount of available information. The features were selected on the basis of two criteria:

- The feature was deemed to be of high ecological, cultural or economic significance.
- There was sufficient information on the distribution and/or abundance of the species to assess its relative importance in the marine planning units at a regional scale.

Based on these criteria, some features identified by CCLCRMP participants could not be included because of lack of data. These features will have to be dealt with on a unit by unit basis as data are made available. The features that are included in the base case are listed below (Table 1). Features which were identified as being important, but for which there was insufficient data to map their distribution in the plan area are also indicated although the discussion of status, trends and distributions of these features is necessarily limited. Anadromous species including salmonids and eulachon are not dealt with in this section of the base case – "Environmental – Marine". These species are dealt with in Part IV of this report "Environmental – Anadromous/Freshwater Fisheries".

Table 1. Marine environmental features identified and included in the Marine Base Case.

Habitats Generally Deemed to be of Especially High Ecological Significance		Included
Intertidal habitats	Estuaries and associated habitats (Salt marshes, Tidal flats, eel grass)	✗
Subtidal habitats	Kelp beds	✓
•	Reefs and their environs	✓
•	Localised upwelling environments	✗
Especially Valued / Familiar Species or Groups of Species		
Marine Fish and Invertebrates *spawning, juvenile nursery, concentrations*	Marine Invertebrates (urchins, sea cucumber, crab, prawn, shrimp, clams, geoduck, abalone, octopus)	✓
	Coastal pelagic fish (herring, pilchard, smelt, sandlance)	✓
	Coastal groundfish (rockfish, Pacific halibut, walleye pollock, Pacific cod, Pacific hake, lingcod, sablefish)	✓
		✓
Marine and Coastal Birds *Nesting sites, colonies, areas of concentration*	Marbled Murrelet	✓
	Colonial alcids - Cassin's Auklet, Rhinoceros Auklet, Pigeon Guillemot	✓
	Storm petrels (Leach's, Fork-tailed)	✓
	Offshore Procellariiformes (shearwaters, fulmars, albatross)	✓
	Nesting gulls (Glaucous-winged Gull)	✓
	Coastal gulls - migratory	✓
	Offshore gulls	✓
	Nesting shorebirds (Black Oystercatcher)	✓
	Migratory shorebirds	✓
	Cormorants (Pelagic, Brandt's, Double-crested Cormorant)	✓
	Waterfowl and Divers (Geese, swans, dabbling ducks, diving ducks, loons, grebes)	✓
Marine Mammals **27.1.1.1.1.1.1.1 Haul outs, breeding sites, areas of concentration**	Sea otters	✓
	Harbour seals	✓
	Sea lions (California, Steller)	✓
	Killer whales	✓
	Gray whales	✓
	Humpback whales	✓
	Pacific white-sided dolphins	✓
	Dall's porpoises	✓
	Harbour porpoises	✓
	Uncommon whales (blue, minke, fin, sei, sperm, northern right)	✗

28. 3.0 MARINE PROTECTED AREAS

The federal and provincial governments have agreed to work collaboratively to exercise their authorities to protect marine areas (Governments of Canada and British Columbia 1998). The inter-governmental MPA Steering Committee was set up in 1994 to develop and integrated MPA strategy for Canada's Pacific coast. The goal is to create an extensive system of marine protected areas by the year 2010 (*ibid.*). The Central Coast LCRMP is central to that regions marine protected area strategy. Regardless of what legislation was used to designate a marine protected area (MPA), all MPAs under the Strategy would:

a) Be defined in law: The legal authority to establish an MPA will derive from one of several federal and provincial statutes including: Canada's *Oceans Act, Fisheries Act, National Parks Act, Canada Wildlife Act, Migratory Birds Convention Act,* or proposed Marine Conservation Areas Act; and British Columbia's *Ecological Reserve Act, Park Act, Wildlife Act* or *Environment and Land Use Act.*
b) Protect all or a portion of the elements within a particular marine environment: The federal and provincial governments have differing and, at times, overlapping jurisdiction in marine areas. Depending upon the statute under which an MPA is created, the area may comprise any combination of the overlying waters, the seabed and underlying subsoil, associated flora and fauna, and historical and cultural features.
c) Ensure Minimum Protection Standards: All MPAs would share Minimum Protection Standards prohibiting ocean dumping, dredging; and the exploration for, or development of, non-renewable resources.

Building on these minimum protection standards, the system of MPAs will accommodate multiple levels of protection. Levels of protection provided by an MPA will vary depending upon the objectives for each site.

There are currently a number of provincial parks with a marine component in or adjacent to the plan area. These parks are managed primarily for recreation rather than for conservation purposes. In addition there are two provincial Ecological Reserves in the plan area that are managed to protect specific marine resources. These include the Robson Bight Ecological Reserve that was established to protect key habitats for killer whales and protect their harassment while using these habitats, and the Duke of Edinburgh Ecological Reserve that was established to protect the largest seabird nesting colony in the Queen Charlotte Strait. Both Reserves are situated within planning unit 13. While Ecological Reserves are managed to prevent the major threats and disturbances, resources are still at risk from oil spills.

There are no federal marine protected areas with in plan area at present. Parks Canada has identified four potential areas of interest for a National Marine Conservation Area (NMCA). At present these are only potential areas of interest and not formal study areas. They include:

- the island archipelagos at the southern end of Queen Charlotte Strait extending up into Tribune Channel. This area falls within planning units 13 and 15.
- the entrance to Queen Charlotte Strait and the North West Coast of Vancouver Island. This area falls within planning unit 13.
- the Goose and Bardswell Islands Groups, Hakai Pass, Goose Island Bank and Roscoe Inlet. This area falls within planning units 5, 6 and 10.
- Ariztazabal Island, Moody Bank and Douglas Channel. This area falls mostly outside of the plan area but does include a small portion of planning unit 1.

National Marine Conservation Areas are marine areas managed for sustainable use and containing smaller zones of high protection. They include the seabed, the water above it and any species which occur there. They may also take in wetlands, estuaries, islands and other coastal lands. NMCAs are protected from such activities as ocean dumping, undersea mining, and oil and gas exploration and development. Traditional fishing activities would be permitted, but managed with the conservation of the ecosystem as the main goal. NMCAs are currently established under the National Parks Act. A Marine Conservation Areas Act is being prepared.

The Department of Fisheries and Oceans has the authority to establish Marine Protected Areas under the Oceans Act. The Oceans Act defines an MPA as an area of the ocean that can designated for the conservation and protection of marine resources and habitats. Under this act MPAs may be designated, zoned and closed to certain activities. The

"National Framework" outlines the general approach that Fisheries and Oceans Canada (DFO) will take to identify, evaluate, establish and manage Marine Protected Areas across Canada. This approach may be further refined in Regional Frameworks to suit local marine conservation and protection needs. DFO has not yet designated MPAs within the plan area.

29. 4.0 COASTAL MARINE HABITATS

The British Columbia coastline supports a large and diverse array of marine plants and animals. Few of these organisms have been surveyed and some are perhaps still unidentified. Organisms tend to be associated with one or more "habitat types". A habitat, in the ecological sense, may described in terms of physical attributes of the environment such as exposure to waves, currents, depth, slope or bottom topography, substrate and bottom sediments. Other factors that may be considered include water quality (salinity, temperature, dissolved oxygen, water-borne sediments and nutrients) and marine plants such as canopy kelps that enhance the complexity of the physical features.

Scientists from both the provincial and federal governments have developed a number of intertidal and shallow subtidal classification schemes for describing these nearshore habitats. The province has used their physical shoreline classification scheme (Howes *et al.* 1994) to map most of the Central Coast plan area based on interpretation of oblique aerial video (John Harper, *pers. comm.*). However, the data were not processed in time to be included in the CCLCRMP Base Case (Mark Zacharias, LUCO, *pers. comm.*). The mapping of the subtidal regions of British Columbia is still in its early stages. The recent advancement of technologies for remotely surveying both the ocean surface and the seabed substrates has opened the way for better knowledge and understanding of this environment (Curran 1996). However, little subtidal habitat information has been mapped to date for the Central Coast plan area other than the distribution of canopy kelp beds and general mapping[70] of areas of high current or subtidal reefs. While we currently have technology capable of mapping the locations of detailed subtidal features, these features are generally so small that they are difficult to map at a regional map scale (1:250,000). It will be up to the local stakeholders to provide information at these large mapping scales (1:20,000 and more detailed).

In the interim, several coastal habitats that are generally considered to have the highest ecological significance were included in the base case analysis. The habitats selected include salt marshes, sea grass beds and tidal flats, canopy kelp beds, subtidal rocky reefs and localised upwelling[71] areas. These nearshore habitats were selected because of their importance to many other species and critical life stages (Dale 1997). Salt marshes, sea grass bed and tidal flats are often associated with estuaries at the head of the mainland inlets although they may also occur in other parts of the plan area. Canopy kelp beds, rocky reefs and areas of upwelling have a greater association with the region of the outer coast of the plan area. Other habitats such as the gravel/cobble beaches where intertidal clams are abundant (clam beds) and long sand beaches used by migrating shore birds are dealt with in the section that is specific to those biota.

29.1 4.1 Management Regime

In British Columbia, the management of the coastal zone is divided between the province and the federal government. The powers and responsibilities of the province of British Columbia relative to the use and protection of the coastal zone include:

- power to issue licences on crown land including the foreshore and sea bottom in inside waterways
- management and control of commercial kelp harvesting
- management and use of Provincial crown land
- management of aquaculture operations
- waste management for aquaculture.

The powers and responsibilities of the federal government relative to the use and protection of the coastal zone include:

- management and use of federal lands
- preservation and protection of fish habitat
- control of marine traffic and pollution in Canadian waters

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[70] At a scale of 1:500,000

[71] Upwelling tends to bring nutrient-rich bottom water into the surface photic layer, resulting in local areas of higher productivity.

- environmental assessment of projects that have any effect on federal lands
- management of fisheries.

Crown land, which includes "land covered by water" and is administered under the "Land Act". The Crown-owned, BC Assets and Lands Corporation (BCALC) is authorised on behalf of the province to undertake the activities related to the development, marketing and sale of all crown land. In BC, submerged lots can no be sold but are leased or licensed for a set period of time for one of a variety of designated activities including aquaculture, marine facilities (docks and other foreshore or offshore structures) and log dumps and booming grounds. BCALC adjudicates applications for leases or licenses of Occupation after referral to appropriate federal, provincial, local and First Nations governments. BCALC uses a variety of siting criteria in evaluating tenure applications depending on the intended activity. Criteria for siting of salmon aquaculture tenures have recently been revised as a result of the salmon aquaculture policy decision. The new guidelines cover:

- Distance to sensitive marine habitats including salmon-bearing streams, salmon holding or rearing areas, marine fish habitat such as herring spawning areas, and intertidal and subtidal shellfish beds.
- Distance to other existing leases or licences, designated boat anchorages or recreational boating areas and to parks or ecological reserves.
- Current use of the site for commercial fishing.

29.2 4.2 Overview of Potential Resource Conflicts

Coastal marine habitats may be affected by physical disturbances to the bottom structure, changes in water quality and activities that alter nearshore sedimentation and littoral drift patterns. Examples of human activities that may effect these changes are given in Table 2. The extent to which impacts will occur depends on many factors, including the habitat type and detailed characteristics such as water flow, existing sediment and water temperature and salinity, and the diligence with which guidelines to protect the environment are followed. More detailed descriptions of these impacts and further documentation can be found in the sections on specific resources or habitats.

Table 2. Human activities which may have impacts upon coastal marine habitats.

Human Activity	Examples of activities	Possible Impacts
Ocean mining	Removal of sand and gravel deposits, mining of placer type deposits	Destruction or alteration of bottom structure resulting in destruction of habitat for marine benthic animal
Dredging	Harbour maintenance	Short term increases in suspended sediments; disruption of benthic fauna and flora; removal of vegetation can locally effect movements of sediment
Fishing	Groundfish trawling, scallop dredges, kelp harvesting	Bottom trawls may reduction of bottom complexity on rocky bottoms and food available to bottom fish in areas of soft sediment
Foreshore structures	Groins, breakwaters	Sediment accumulation or loss depending on location
Waste disposal	Sewage outfalls, seepage from septic tanks, discharge from boats	Eutrophication; reduction in water clarity
Forestry	Log storage and handling	Debris from log handling settles on the bottom reduces bottom reduces dissolved oxygen and light available to benthos resulting in reduced biomass and diversity; foreshore log storage impacts local sediments
	Vegetation removal from backshore	Sedimentation in nearshore areas resulting from increased backshore run-off.
Mariculture	Open water pen rearing of salmonids, hanging culture of shellfish	Local hyper-eutrophication, sedimentation, shading
	Bottom culture of shellfish	Displacement of other intertidal flora/fauna; change in sediment transport.
Transport	bulk fuel carriers, transport of goods, recreation	Oil pollution; introduction of exotic species in ballast, contamination from bottom pain, lead contamination from battery disposal (from boats, navigation buoys); introduction of exotic species in ships ballast

29.3 4.3 Individual Accounts for Nearshore Habitats

29.3.1 *4.3.1* Salt marshes, sea grass bed and tidal flats

Salt marshes, sea grass bed and tidal flats are often associated with estuaries at the head of the mainland inlets. Estuaries are some of the most highly productive habitats in the coast zone Vermeer and Butler 1994). While estuaries typically have a low diversity of planktonic and benthic species that can tolerate fluctuating salinity regimes, those species that are present tend to be abundant. Wildlife and fish species at higher trophic levels are attracted to this abundant food source and the shelter from the surrounding lands.

Distribution: Mapping of these intertidal and shallow subtidal habitats was not available for this analysis and so analysis of their distribution is not attempted at this time. From their association with mainland inlet estuaries, it may inferred that they would be most abundant in planning units 1, 3, 6, 7, 9, 11, 14, 15 and 16.

Potential Resource Conflicts: The shallow, sheltered waters of estuaries are used for log dumps and storage and docking facilities within the Central Coast plan area. Coastal marine log dumps and storage generate wood waste that may have significant effects on the sediments and associated marine benthos (*ibid.*; Conlan and Ellis 1979; Kathman *et al*. 1984). Impacts associated with log handling include smothering of benthos, lowered dissolved oxygen and toxicity from leachates (*ibid.*). The species most negatively impacted are bivalve molluscs while an increase in polychaete worms and harpacticoid amphipods has been reported (*ibid.*). The latter two species are thought to predate on bivalve larvae thereby further depressing their population recovery (McGreer *et al.* 1985). Intertidal storage of logs has the additional ecological effect of compacting sediments under grounded logs (McGreer *et al.* 1984). This can result in reduced pore water space, decreased interstitial densities, decreased water circulation and development of an anoxic layer of sediment (*ibid.*). The meiofauna in these log storage areas also tends to be dominated by in polychaete worms and harpacticoid amphipods with few bivalve molluscs (*ibid.*). Eelgrass beds may be severely reduced or eliminated in log storage areas with the consequent loss of associated species (Waldichuk 1979).

29.3.2 *4.3.2* Rocky Reefs

Intertidal and shallow subtidal rocky reefs provide a highly complex bottom type that is important for commercial groundfish such as lingcod and some rockfish. They also provide a diverse habitat for micro- and macro-algae, benthic invertebrates and many species of non-commercial fish. Reefs include areas with hard rock bottom with complexity created by the presence of rocky outcrops often surrounded by boulders and/or cobble.

Distribution: There has been no systematic field survey to map rocky reef ecosystems in the central coast region. It is possible to infer from the coastal geology and maps of bathymetry where the highest concentrations of these reefs probably occur. Such an analysis suggests that rocky reefs are most abundant along the outer coast of Queen Charlotte Sound (Planning Units 5, 6 and 10) and in Queen Charlotte Strait (Planning Unit 13) around the Broughton Archipelago and from Nigei/Gordon Islands across to the Deserters and Walker Group (Booth *et al.* 1998).

Potential Resource Conflicts: The structure of the rock reef ecosystem can be altered by physical damage to the structure caused by underwater mining. The province issued a moratorium on any mineral rights below the high water mark in 1973 and this remains in effect to the present. Although trawls try to avoid the high profile reef habitats, damage from commercial fishing using gear such as trawls or dredges that drag over the bottom may occur in the surrounding boulder fields. While there is no dredging in the plan area, bottom trawling occurs in both Queen Charlotte Strait and Queen Charlotte Sound. The types of damage reported includes a tendency to smooth out structures on the bottom, remove emergent epifauna and remove bottom fauna that contribute to sea floor complexity (Dorsey and Pederson 1997; Freese *et al.* 1999).

29.3.3 *4.3.3* Canopy Kelp Beds

Kelp canopies are formed primarily by species of the genera *Macrocystis* and *Nereocystis*. Canopy kelp beds are one of the few subtidal habitats that can be mapped from aerial surveys. As a result they are the only subtidal habitat of especially high ecological significance for which there is good baseline data for the whole Central Coast plan area. In several areas of the CCLCRMP planning area, there have been detailed kelp surveys that include species identification and biomass estimates. Information from these surveys has been supplemented with information taken from the hydrographic charts. The ecosystems associated with canopy kelp beds are highly productive. The kelp beds provide important habitats for many fish and invertebrate species including use by spawning herring.

Distribution: Canopy kelp beds are generally located along exposed and semi-exposed coastlines and in areas of upwelling or high current channels where nutrient levels are high and a rocky substrate is available. In British Columbia, *Macrocystis* is restricted to areas where there is little variation in temperature and salinity or where periods of low salinity coincide with cold winter water. *Nereocystis* tolerates a wide range of temperatures and salinity. The kelp fronds are attached by a "holdfast" to rocky substrates and grow from the zero tide level, or just above, to about minus 12 metres depending on the water clarity. Kelp may grow on unstable substrates such as cobble but beds tend to be more ephemeral in such areas. Marine planning units within the Central Coast plan area which have the greatest abundance of these habitats (and hence the greatest concentrations of canopy kelp beds) include units 5, 10, 13 and 14 (Table 3).

The area of Hakai Pass to the Bardswell group within Planning Unit 5 has been of particular interest because of the high standing crop of kelp and the significance of the kelp in rebuilding populations of sea otters. This area is partly contained within the Hakai Recreation Area. Other extensive stands of canopy kelp that have been surveyed in the planning region are three areas located within Planning Unit 13: Malcolm Island, the north end of Vancouver Island, and the Estevan Group.

Table 3. Abundance of canopy kelp beds in Central Coast marine planning units.

Planning Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Area of Planning Unit*	149	289	538	455	826	580	949	492	236	2387	139	270	1995	269	1183	260
Area of kelp beds*	0.45	0.578	1.614	0.45	17.34	1.74	0	2.46	0.47	9.55	0.42	1.62	33.9	3.77	20.11	0
% Planning Unit covered by kelp beds	0.3	0.2	0.3	0.1	2.1	0.3	0	0.5	0.2	0.4	0.3	0.6	1.7	1.4	1.7	0

*All areas in km²

Potential Resource Conflicts: Kelp beds change seasonally in both area and biomass (Coon 1982; Foreman 1984) although over longer time frames they tend to be fairly constant in composition and abundance (Watson 1992). The macroscopic form of *Macrocystis* may live three or more years while *Nereocystis* is an annual. The major causes of mortality in kelps are winter storms and grazing by herbivorous marine invertebrates such as urchins. Fluctuations in populations of these species may effect the size and density of kelp beds. Kelp has been harvested commercially in BC, and, research to date indicates that the impacts of harvesting on kelp plants at the sea bed are short term as the plants rapidly grow new fronds (Coon 1982; Watson 1992). Changes in environmental parameters, such as water temperature or turbidity, can affect species composition and abundance within a kelp bed (North *et al.* 1990; Ambrose and Nelson 1982; Dean and Deysher in Watson 1992).

30. 5.0 MARINE FISH AND INVERTEBRATES

Knowledge of the stocks of marine fish and invertebrate species in the planning area is primarily limited to those species which are fished by the commercial, recreational or native fisheries. Most of our knowledge of the abundance and distribution of the fish and invertebrates comes from these fisheries and as a result may be slightly biased by factors such as:

- the price of fish
- inaccessibility of some areas due to the fishing gear used (e.g. water depths too deep for economical fishing, grounds too rough for trawling)
- seasonal or life cycle migrations of species
- areas closed to the fishery for conservation, contamination or other reasons
- different distributions of life history stages not included in the fishery
- some stocks not currently exploited throughout their range due to remoteness of processing plants and freezers, limited abundance in a region or too low demand for the species.

These biases are taken into consideration when assessing the stock status, however, our knowledge of the status of many species is incomplete because of the lack of direct biological information. Similarly, actual distribution of the species is more widespread than the location of the fishery although the latter is often the only systematic distribution data that has been collected.

The marine invertebrate species groups that were selected for this analysis include: sea urchins, sea cucumbers, crab, prawn/shrimp, clams, geoduck, abalone, squid, and octopus. The marine fish species which were selected for this analysis include: herring, pilchard (Pacific sardine), smelt, sandlance, rockfish, Pacific halibut, other flatfish, walleye pollock, Pacific cod, Pacific hake, lingcod, and sablefish. These species were selected because of their commercial importance in BC. Species that are not commercially fished have little information available on their distribution and status and at present can only be assessed from an analysis of the limited information available on their habitats.

30.1 5.1 Management Regime

The Fisheries Act was first enacted in Queen Victoria's time, although it has been amended many times since, most recently in 1991. The Canadian waters are divided into Areas and Sub-areas based on *Pacific Fishery Management Area Regulations*. Commercial Fishing is regulated under *the Pacific Fishery Regulations, 1993*, sport fishing under the *British Columbia Sport Fishing Regulations, 1996* and foreign fishing under the *Coastal Fisheries Protection Regulations*. The regulations set out details of what species can be fished, what gear can be used, configuration of the gear, quotas, area and seasonal closures, importation of exotic species and the registration and licensing of fishers and vessels. All marine mammals, fish, invertebrates and plants are included under the act.

The Minister and the Department of Fisheries and Oceans have, for some time, been working more closely with their clients and with other governments.

30.2 5.2 Overview of Potential Resource Conflicts

Natural changes in the marine environment such as changes in sea-surface temperature and current patterns are an important factor in the distribution and abundance of most marine fish species. Human activities can also have considerable impacts on marine fishes. The main resource conflicts between marine fish and invertebrate species and human activities may arise from:

- **Industrial pollutants**: Currently there are no major sources of industrial pollutants on the central coast other than sources of forestry waste and potential oil pollutants. Pulp mills and other point sources of marine toxins could impact on fish and invertebrates in the region if new industries developed (Goyette 1994; Schmitt *et al.* 1994).
- **Oil spills**: The risk of a catastrophic oil spill is currently quite low and comes only from tanker traffic from Valdez Alaska to the Strait of Juan de Fuca. If the moratorium on offshore oil and gas exploration was removed additional risk would come from off-shore leases in Queen Charlotte Sound and Hecate Strait (Enemark Part 1 this report). There is also risk of smaller oil spills from oil barges transporting fuel to local diesel generators supporting

operations and communities on the coast. The release of bilge water though illegal flushing or from intentional scuttling or unintentional sinking of boats may result in localised oil pollution. Catastrophic, chronic or small local oil spills all could can have an impacts on fish and invertebrate populations on the central coast, especially on intertidal and shallow subtidal benthic species with limited mobility and on egg, larval and juvenile stages. The other major impact of oil contamination is through the tainting of fish and shellfish that can effect taste and appearance of the fish resulting in lowered consumer demand and sometimes closure of an area to fishing.

- **Forestry activities**: One of the most common types of spoil dumped into Canadian coastal waters is material rich in wood wastes such as bark, wood debris, fibres or chips (McGreer *et al.* 1985). This wood waste is generated by a variety of forestry related activities including sawmills, pulp mills, and log storage and sorting facilities. The wood waste may have significant effects on the sediments and associated marine benthos (*ibid.*; Conlan and Ellis 1979; Kathman *et al.* 1984). Impacts associated with log handling include smothering of benthos, lowered dissolved oxygen and toxicity from leachates (*ibid.*). Intertidal storage of logs has the additional ecological effect of compacting sediments under grounded logs (McGreer *et al.* 1984). This can result in reduced pore water space, decreased interstitial densities, decreased water circulation and development of an anoxic layer of sediment (*ibid.*). Eelgrass beds may be severely reduced or eliminated in log storage areas with the consequent loss of associated species (Waldichuk 1979).
- **Aquaculture operations**: The primary forms of aquaculture in British Columbia involve the net cage farming of Atlantic salmon and bottom or hanging culture of the Japanese oyster. The culture of other bivalve species (scallops, clams and mussels) is growing but much less extensive than oyster culture. There is the potential for the culture of other fish species and/or marine plants in the future on the central coast. Net-cage fish farms release a number of wastes into the surrounding marine environment. These include uneaten fish food, fish excretory products and organic matter from cleaning of the net cages (Burd 1997). The major components of these wastes are various forms of carbon, nitrogen and phosphorus (*ibid.).* Other minor components of concern are anti-microbial drugs, pesticides and metals (e.g. zinc). Increased nutrients can lead to higher levels of primary production water column in the local area around the cages (*ibid.*) and the local meiofauna may be affected by anoxia resulting from the build-up of sediments under and around the net cages (*ibid.*; Mazzala et al. 1999). Both decreases in the meiofaunal density and changes in the species assemblages have been reported (Mazzala et al. 1999). There has been some concern expressed about the assimilation of anti-microbial drugs, pesticides and metals (e.g. zinc) by benthic organisms, however, there have been no documented effects on wild fish populations from chemicals currently in use in BC fish farms (*ibid.*). An additional concern is the introduction of exotic species into BC waters through imports for aquaculture. Both the Japanese oyster (*Crassostrea gigas*) and the Manilla clam (*Venerupis philippinarum*) were introduced to BC waters many years ago and are now an integral part of the seashore. There is considerable concern over the more recent accidental introduction of Atlantic salmon. The ability of this species to establish itself on the BC coast is not yet known and any ecological impacts that might arise from the establishment of wild populations of Atlantic salmon are still speculative.
- **Foreshore construction:** Shoreline structures such as groins or in-filling of intertidal or shallow sub-tidal areas may lead to loss or degradation of foreshore habitats for nearshore fish species such as herring.
- **Sewage disposal:** Domestic sewage and other non-point source pollution such as urban and agricultural runoff may cause local eutrophication and a change in the community structure of fish and their prey (Waldichuk 1989). Eutrophication can lead to faecal colliform contamination of shellfish beds and indicate that pathogenic bacteria and viruses may be present – resulting in shellfish closures (*ibid.*) although the shellfish population itself may not be detrimentally effected.
- **Fishing**: Fishing itself has had the most significant influence on stock size, population structure and distribution of commercially fished fish and invertebrate species. Some kinds of fishing may affect fish populations indirectly by their impact on the environment (e.g. bottom trawling or hydraulic dredging). Direct impacts include "ghost fishing" by lost nets and traps or incidental catch of life stages or which are not intentionally targeted (bycatch and discards). There is also growing concern that overfishing of a species can lead to a shift in the species complex present in an area (Perry 1999). For example overfishing of Gadoids and flatfish on Georges Bank has resulted in their decline and replacement by sharks and skates (Fogarty and Murawski 1998 in Perry 1999).
- **Mining activities and wastes**: Subtidal mining can have impacts upon the local habitat and may cause local sediment problems. Tailings from coastal land-based mining can cause siltation in coastal waters. The disposal of land-based mine tailings into coastal inlets can result in problems of siltation under certain conditions (Waldichuk 1978).
- **Transportation (impacts other than oil pollution)**: The dumping of ship ballast has been identified as a possible means by which exotic species can be introduced. This problem is not restricted to local areas as seen by the recent

expansion of the European green crab that first appeared in California and has subsequently spread north into BC waters

30.3 5.3 Individual Accounts for Species-Groups

30.3.1 *5.3.1* Marine Invertebrates

A large number of marine invertebrates are currently fished or have the potential to be fished in the Central Coast Planning Area. The Department of Fisheries and Oceans (DFO) collects detailed information on the location and abundance of most invertebrate fisheries from log books submitted by the fishers to DFO as part of their licensing regulations. The information collected from log books, however, is confidential and was not available for this analysis. The DFO scientists were only able to provide information as to whether the presence of a species in a DFO statistical area was known or unknown. While certain species of invertebrates have been subject to detailed stock assessments (e.g. northern abalone),. there is a paucity of knowledge of the population status and distribution of many of the invertebrate species. The expected trends of these invertebrate populations in the absence of an LRMP have been summarised in Table 4 below.

Table 4. Expected trends of invertebrate species in the central coast plan area in the absence of an LCRMP.

Species	Trend
Urchins	Stable. Have been overfished in some areas in the past. On-going surveys.
Sea cucumbers	No information. Can be affected locally by habitat deterioration from human activities
Crabs	Subject to fluctuations caused by abiotic environment. Juveniles in nearshore sensitive to habitat loss and local impacts could affect local populations. On-going surveys.
Shrimps/ prawns	
Intertidal clams	Stable. May be locally overfished. Log storage or foreshore structures may locally affect beds.
Geoduck	Stable. On-going surveys.
Abalone	Declining. Poaching has resulted in continued decline in population
Octopus	No information. Subject to natural variation in abundance. Loss of habitat (suitable den sites) can reduce local abundance.

30.3.1.1 Red/Green Sea Urchin

In British Columbia the three most common species of sea urchin are the red *(Strongylcentrotus franciscanus)*, the purple sea urchin (*S. purpuratus*) and the green urchin (*S. droebachiensis*). Only the red and green urchin species are commercially harvested for their roe at this time. All urchin fisheries are by limited entry with "individual vessel quotas" (IVQ) and a "total allowable catch" (TAC) (B. Atkins, pers. comm.). Green sea urchin fishing in the plan area is limited and only permitted under an exploratory harvest protocol (*ibid.*). Red sea urchin quotas are precautionary and based on assessment information where available (*ibid.*). North of Cape Caution (DFO North Coast Region) biological information is limited and quotas are largely abitrary (Stocker and Joyce 1998). Sea urchins graze on fleshy marine algae, such as kelp species, and when large numbers are present areas devoid of algae known as "urchin barrens" may be created.

Population size and Trends: The green sea urchin fishery began in 1987 and developed rapidly in areas south of Cape Caution to the point where stock depletion became evident (Perry and Waddell 1999). Recent (1999) biomass models suggest that the green sea urchin stock in Johnstone and Queen Charlotte Straits (DFO statistical areas 11-13) is now relatively abundant with recent good recruitment (Perry and Waddell 1999). Similar information for green urchins the DFO North Coast portion of the plan area is not available. Biological information on the red sea urchin population in the north coast region is (Stocker and Joyce 1998). Currently, there is no fishery for purple sea urchin and the stock status is poorly known.

Otters will and are having an impact on sea urchin abundance (B. Atkins, pers. comm.). The long-term trend in some areas of the central coast is likely a decline in urchin abundance and an increase in otter abundance (*ibid.*).

Distribution: Urchins are primarily found on rocky bottoms in the lower intertidal and shallow subtidal waters throughout the plan area. Purple urchins are found in the most wave-exposed areas while red and green urchins are more abundant in some wave-protected areas. Most of the fishery in the plan area is for red sea urchin and is located primarily along the outer coasts of Price, Hunter and Athlon Islands, the Sidmond Group and in Kitasu and Thompson Bays in Planning Unit 5 (**Table 5**). Green sea urchins are currently fished on the north coast under exploratory permit only at the discretion of DFO fishery managers. In the DFO South Coast region (southern plan area south of Cape Caution), green urchin quotas are assigned by DFO statistical area. In 1998/99, the largest quota on the South Coast was assigned to DFO statistical area 12 (that is encompassed primarily by Planning Unit 13) where fishing takes place around the small islands north west of Hanson Island.

Table 5. Area (in km²) of sea urchin fisheries by marine planning unit.

Marine	Planning Unit															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Unprotected		25.59	12.45	1.12	150.4	32.73	5.89	14.97		42.02	0.34		8.92		2.30	
Protected			0.37		56.64	13.66		14.36		43.37			1.77		0.04	
Total		25.59	12.82	1.12	207	46.39	5.89	29.33		85.39	0.34		10.69		2.34	

Potential Resource Conflicts: The factors that control the abundance of sea urchin populations are not clear (Watson 1992). The fishery can have an effect and urchin populations went through a period of decline following the rapid expansion of the fishery that began in 1987 (Perry and Waddell 1999). The sea urchin dive fishery began in the 1970s and both red and green sea urchins are commercially harvested in the plan area for their roe. There was an experimental fishery for purple urchins in BC, however this fishery is now closed. The urchin fisheries in the region increased rapidly in the late 1980s but have subsequently been reduced and stabilised by management practices including "block" fishing that spreads the fishing out over the area and prevents local over-fishing. There are several areas closed to urchin fishing except for research purposes. Within the plan area, urchin closures are in effect in Port Neville, Neill Ledge (Port McNeill), and Stubbs Island/Plumper Islands, all of which are located in Planning Unit 13. There is some mortality of urchins damaged but not captured by the urchin fishery, however, the extent of this handling mortality is not known at this time (Stocker and Winther 1999).

30.3.1.2 Sea Cucumbers

While there are several sea cucumber species in BC waters, there is only information on one species, *Parastichopus californicus*, for which there is a commercial fishery.

Population Size and Trends: Sea cucumbers are a common, widespread invertebrate throughout the coast of BC. The fishery for the *P. californicus* species is not large and there is no information on the size or trend of the species in the plan area. The species is sedentary except for a brief planktonic larval period and populations are probably local.

Distribution: Sea cucumbers are most common on bedrock substrates in areas with little or no current where debris accumulates. They are also found on sand, gravel or mud bottoms and often in eelgrass beds. The larvae are planktonic and the young settle out into shallow nearshore areas in algal beds or rocky crevices. Their depth range is from the intertidal to 90 m. There is not an extensive fishery for sea cucumber in BC. Within the plan area there are several small areas of commercial beds scattered along the outer coast north of Cape Caution (Table 6).

Table 6. Area (in km²) of commercial sea cucumber beds by marine planning unit.

Marine	Marine planning unit															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Unprotected	6.83	9.59	20.61		16.03	41.6	14.07		0.71		0.045					
Protected	0.14				13.57	23.2				0.19						
Total	6.97	9.59	20.61		29.60	64.8	14.07		0.71	0.19	0.045					

Potential Resource Conflicts: Locally, the commercial dive fishery could reduce the size of populations. Management recognises the lack of information on this fishery and the fishery has fixed exploitation rates and is limited to 25% of the coast in non-contiguous harvest areas (Hand and Rogers 1999). There are ongoing surveys and an additional 25% of the coast is open to an experimental fishery under guidelines developed by DFO (*ibid.*). Two experimental fishing areas are present in the plan area in Larado Inlet and Tolmie Channel (*ibid.*). Sea cucumbers are thought to have limited mobility although there is some anecdotal information that they undergo seasonal bathymetric migrations (*ibid.*). Nearshore habitat deterioration resulting from log storage could cause individuals in the immediate area to move away. A fish farm located inappropriately in an area with insufficient water flow to prevent significant sediment accumulation could have a similar effect.

30.3.1.3 Crab

Although there are over 80 species of crab found in BC waters (Hart 1982), only one species is targeted by a substantial commercial fishery, the Dungeness crab (*Cancer magister*). The red rock crab (*C. productus*) is taken by recreational fishers.

Population Size and Trends: The fishery for Dungeness crab in BC occurs mostly in areas outside of the plan area. Some Dungeness crab populations are subject to large-scale fluctuations thought to be primarily caused by abiotic environmental factors (Hankin 1985). The introduced European green crab has recently spread into BC waters and although it has not been found in the plan area there is fear that it will eventually reach this area. The green crab may feed on juvenile crabs of other species, including Dungeness and red rock crabs, or may compete with them for food resulting in a population decline of these more valued species.

Distribution: There are no large commercial fishing areas within the plan area for Dungeness crab. This probably reflects the lack of suitable habitat –shallow, sand bottom areas with high water exchange. Small areas of abundance (where fishing takes place) are located in most planning units. The closest major crab fisheries are located in northern Hecate Strait to the west of the plan area and in the Skeena River estuary.

Table 7. Area (in km²) of commercial crab fishing by marine planning unit.

Marine	Marine planning unit															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Unprotected	4.50		3.95			38.37	6.11		11.12		8.06	9.86	12.09	8.28	60.42	194.0
Protected					0.07			9.76		24.51						
Total	5.5		6.95		0.07	44.37	13.11	9.76	20.12	24.51	19.06	21.86	25.09	22.28	75.12	194.0

Potential Resource Conflicts: Juvenile Dungeness crabs concentrate in coastal estuaries (Armstrong and Gunderson 1985) and are therefore more susceptible to impacts from human activities which tend to be concentrated in those locations. Somatic and reproductive anomalies resulting in lowered reproductive success have been documented as resulting from benthic bark deposits found at a log transfer site (O'Clair and Freese 1985; Freese and O'Clair 1985). As Dungeness crab larvae are widely dispersed after hatching impacts on local reproductive capacity may not have large impacts on local recruitment.

30.3.1.4 Shrimp and Prawn

There are over 87 species of shrimp and prawns found in BC waters, seven species in sufficient numbers to support several small commercial and recreational trap and trawl fisheries in BC, northern pink shrimp (*Pandulus borealis eous*), prawn *(P. platyceros)*, humpback shrimp (*P. hypsinotus*), smooth pink shrimp (*P. jordani*), coonstripe shrimp (*P. danae*), flexed pink shrimp (*P. goniurus*) and sidestripe shrimp (*Pandalopsis dispar*). While all shrimp species (except the sidestripe) will enter a trap, only the coonstripe shrimp, humpback shrimp and prawn are currently targeted this way because of their preference for rocky bottom. The other species are generally caught by trawl on soft, generally muddy, bottom. The species caught most frequently in the trawl fishery are the smooth pink, sidestripe and northern pink shrimp (Hay et al. 1999).

All seven shrimp species are hermaphroditic, starting out life as males and becoming females after one to two years. Mature shrimp breed in the late autumn or early winter and the females carry the eggs until they hatch in the spring (Butler 1980). Larval shrimp are planktonic for about three months, where they may be subject to transportation by tides and currents, before they settle to the bottom (*ibid.*). Once the juveniles settle, however, they seem to be relatively sedentary. Some species (e.g. Humpback shrimp) inhabit shallow depths as juveniles (0+) moving to deeper water as they age (Buyanovsky 1999). As adults the various shrimp species occupy slightly different habitats; the smooth shrimp is generally found offshore along the continental shelf, the coonstripe shrimp in inland areas areas with high currents and sand or gravel bottom, the northern pink, and sidestripe shrimp on muddy bottoms in mainland inlets and the humpback shrimp and prawn on muddy bottoms in mainland inlets.

The suspected limited mobility of adult populations implies that there may be hundreds of separate stocks, however, the concept of meta-populations that share larvae may well apply to prawns and shrimp because of their lengthy pelagic larval stage (Boutillier and Bond 1999). Good recruitment of a single year-class over a fairly large area has occurred at times, however, this may be due to good environmental conditions over a large area having a positive effect on a number of populations, rather than a single population response (*ibid.*). There are instances of a single year class settling in a particular area, spending its life there then leaving the area virtually barren when the year class dies off (*ibid.*).

Population Size and Trends: The stock status of shrimp species is poorly known however assessment programs have recently been initiated (DFO 1999a). The prawn fishery is a very competitive fishery and most stocks on the coast are thought to be fully exploited to the point where the minimum escapement is occurring in most populations of the region (DFO 1999b). Since 1995 prawn stocks have been more closely monitored and are currently thought to be healthy in most coastal areas (*ibid.*).

To the north, in the Gulf of Alaska Pandalid shrimp have undergone significant population declines since the late 1970s coinciding with a significant warming trend (Anderson 1999). There is evidence that the more shallow distributed members of pandalidae were more vulnerable to being extinguished from the near-shore ecosystem due to the 1977 climate change (*ibid.*). These coastwide declines have not been observed in BC.

Distribution: While shrimp are located in most of the mainland inlets within the plan area south of Namu, they are most abundant (as indicated by the distribution of the fishery) in those planning units that encompass mainland inlets south of Namu (Table 8). After completing their relatively long planktonic larval stage, shrimp settle and generally remain in shallow bays and inlets where food is more abundant the first year and then move offshore to depths of 5-406 metres. Adult shrimp are caught by trap or trawl on or near the bottom in water depths of 27 to 200 metres. The habitat, behavior and migration of shrimp vary for each shrimp species. For example, the smooth pink shrimp (*Pandalus jordani*), shows substantial changes in distribution over the year, both in vertical distribution and spatial distribution while some stocks of sidestripe shrimp (*Pandalopsis dispar*) indicate very limited movement.

Table 8. Area (in km²) of commercial fishery for prawns and shrimp by marine planning unit.

Marine Protected Area	Marine planning unit															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Unprotected							4.88		1.08			115.48	3.47	135.87	330.23	
Protected															1.11	94.0
Total							4.88		1.08			115.48	3.47	135.87	346.34	94.0

Potential Resource Conflicts: The shrimp species and stages in nearshore areas are most vulnerable to habitat alteration. Debris from log handling can significantly effect the local bethos and local concentrations of shrimp may disappear, although the population may not be greatly effected.

The major impacts on the shrimp stocks probably come from the commercial fishing fleet. There is some concern that the shrimp stocks cannot support the current size of the commercial fleet (DFO 1999). The central coast is currently of minor importance to the trawl fishery and 80-90% of the catch is taken from offshore the west coast of Vancouver Island (ibid.)..

There are general concerns about the quantity and diversity of the bycatch in the shrimp trawl fishery. There are bycatch limits set for prawns in the trawl fishery. There are conservation concerns about bycatch of a particular species, the anadramous smelt, the eulachon *Thaleichthys pacificus* (Osmeridae). Eulachons are one of the most abundant of the bycatch species and there is a developing conservation concern for eulachons in many areas of the Pacific coast. Eulachons are dealt with in detail in Part IV of this report – Anadromous Species.

30.3.1.5 Intertidal Clams

Four species of intertidal clam are harvested in British Columbia, the manila (*Venerupis philipinaarum*), littleneck (*Protothaca staminea*), butter (*Saxidomus giganteus*) and razor clam (*Silqua patula*). The manila clam was accidentally introduced to the west coast of Vancouver Island from Japan along with Pacific oyster seed in the 1930s and had spread along the BC coast into Queen Charlotte Strait by the 1960s and the Central Coast by the 1970s (Bourne 1982).

Population Size and Trends: There is no information on the status and trends of north coast intertidal clam populations. Clams have been harvested for thousands of years in the region as demonstrated by the numerous middens found there. Fluctuations in the landings of intertidal clams generally reflects the market demand and not the biomass of the stock (Bourne 1986).

Manila clams are less abundant in the plan area than the littleneck and butter clam species (B. Atkins, pers. comm.). The razor clam is uncommon in the plan area and the only extensive populations in BC are in the Queen Charlotte Islands and the Southwest coast of Vancouver Island. The European green crab has recently been discovered in BC waters and while this species has not yet been found in the plan area it is known to predate on intertidal clams. There may be some impact on local clam populations if this species moves into the area.

Distribution: Manila, littleneck and butter clams are found in soft substrates in the intertidal zone and the latter two species are also found in the shallow subtidal tidal zone. They are most abundant in areas where the substrate is gravel mixed with sand or mud. Clam beds have been mapped for a small portion of the plan area (Planning Units 13, 14 and 15) from anecdotal information collected from fishery officers. There have been surveys to assess clam popualtions on selected beaches in the DFO North Coast District and Queen Charlotte Strait areas by DFO research staff (Bourne and Cawdell 1997; Bourne et al. 1994; Harbo et al. 1997) but except for parts of area 7 (planning unit 5) none are currently commercially harvested. There are probably thousands of beaches throughout the region with clam populations and the population age and species structure can vary substantially within a short distance (*ibid.*).

Potential Resource Conflicts: Local adult clam populations can be depleted by harvesting, however, size limits ensure that a portion of the reproductive population is left to re-seed the beds. It is unlikely that clam beds north of Cape Caution (DFO North coast Region) have been overfished as there has been a closure of almost all north coast areas for the past 30 years due to problems with Paralytic Shellfish Poisoning (PSP) and Domonic Acid (ASP) (Bourne 1996; B. Atkins, pers. comm.; DFO 1999 Clam management Plan). The exception is the Heiltsuk co-managed fishery in

Area 7. This fishery is conducted under a management plan that sets harvest levels based on stock assessments (B. Atkins, pers. comm.). There is a growing interest in developing intertidal clam fisheries in north coast areas (DFO 1999 Clam Management Plan)..

Clam fisheries are susceptible to impacts from nearshore and backshore human activities that result in siltation or changes in the sediment regime of the clam beaches. Foreshore structures which obstruct the movement of coastal sediments can erode clam beaches. Wood waste from log handling (storage and dumping) may have significant effects on the sediments and associated marine benthos (McGreer *et al.* 1985; Conlan and Ellis 1979; Kathman *et al.* 1984). Impacts associated with log handling include smothering of benthos, lowered dissolved oxygen and toxicity from leachates (*ibid.*). The species most negatively impacted are bivalve molluscs while an increase in polychaete worms and harpacticoid amphipods has been reported (*ibid.*). The latter two species are thought to predate on bivalve larvae thereby further depressing their population recovery (McGreer *et al.* 1985). Intertidal storage of logs has the additional ecological effect of compacting sediments under grounded logs (McGreer *et al.* 1984). This can result in reduced pore water space, decreased interstitial densities, decreased water circulation and development of an anoxic layer of sediment (*ibid.*). The meiofauna in these log storage areas also tends to be dominated by in polychaete worms and harpacticoid amphipods with few bivalve molluscs (*ibid.*). Although fish farms would generally be sited in waters deeper than most clam beds, fish farms sited in close proximity to beds could possibly increase the rate of sediment deposition over the beds, resulting in decreased production. Industrial or domestic sewage pollution can affect the harvest of intertidal clams, however, the population is not necessarily negatively affected.

30.3.1.6 Geoduck

Population Status and Trends: The geoduck clam (*Panopea abrupta*) has been conservatively managed since 1979 when limited entry came into effect and harvest quotas were set for conservation. There is no information on the current status of the population in the plan area although the location and biomass of geoduck beds have been mapped in areas just to the north of the region. The species is long-lived (>100 years) and has high reproductive potential; females are reproductive at age 4 and by age 12 reach full reproductive potential with seven to ten million eggs per year (Hand 1998).

Distribution: Geoducks are distributed throughout the north-east Pacific from Alaska to the Gulf of California in soft substrates between 0 and 110 m (Hand 1998). Commercial fishing on the BC coast is rotated between areas. There was no commercial geoduck fishing in the plan area in 1999 (DFO Pacific Region Geoduck and Horse Clam Management Plan 1999) but fishing has occurred in other year and may occur in subsequent year. It is thought that there are still beds in the North coast area that have not yet been discovered (Hand 1998).

Potential Resource Conflicts: Geoducks have been fished in southern British Columbia (including Planning Units 13, 14, 15 and 16) since 1976 and on the north coast (Planning Units 1 – 12) since 1980 (Hand 1998). Individual geoduck beds are mapped and the allowed harvest is 1% of the virgin (pre-fishing) biomass (*ibid.*). The management practice for geoducks is conservative and designed to ensure long-term viability of the resource. About 9% of the geoduck beds coastwide are thought to have been over-harvested and these particular beds are now closed to fishing to allow them to recover (ibid.). Natural refugia, where the water depth is too deep for divers or the substrate makes extraction too difficult, are thought to form a natural reserve of breeding animals which could restock over-fished areas (*ibid.*). Other human activities that could affect geoducks would be any activity which changes the bottom substrate such as direct addition or removal of substrate (ocean dumping or dredging), logging practices that cause land slides transporting sediment into nearshore regions, or activities which reduced dissolved oxygen in the bottom sediments such as log storage or local eutrophication from sewage. Fish farms that are poorly sited such that local eutrophication occurs can also cause

30.3.1.7 Abalone

Population Size and Trends: The northern abalone (*Haliotis kamtschatkana*) has been exploited by man for thousands of years. A directed commercial fishery began in about 1976 and in the period between 1978-84, the high demand for abalone resulted in unprecedented exploitation and the stock was depleted by a factor of about 75% (Campbell 1997). A small commercial, aboriginal and recreational fishery continued until 1990 when, faced with the collapse of the population, the fishery was closed to all user groups (*ibid.*). Despite the fishery closure, abalone stocks on the central coast continued to decline between surveys in 1993 and 1997 (Campbell *et al.* 1998); the most likely reason for this continued decline in abalone is illegal poaching in the region (*ibid.*) and biological factors may also play a role (B. Atkins, pers. comm.). The northern abalone is currently on the Committee on the Status of Endangered Wildlife in Canada's (COSEWIC) list of endangered species. The long-term trend for abalone stocks in the plan area may be one of improvement as DFO is moving towards implementation of a stock re-building initiative (B. Atkins, pers. comm.).

Distribution: During the period from 1976 to 1979 the commercial abalone fishery had two main fishing areas in the plan area; Queen Charlotte Strait, centred around Port Hardy (Planning Unit 13) and off Athlone Island just north of the Hakai Recreation area (Breen 1986).

Potential Resource Conflicts: Currently the human activity with the most severe impact on northern abalone stocks is illegal harvesting (poaching). Poaching not only reduces the immediate size of the population, but it does not adhere to size limits and much of the reproductive potential of the population is removed, slowing down the recovery process (Campbell *et al.* 1998).

30.3.1.8 Octopus

Although there are possibly nine species of octopus in BC water (Gillespie *et al.* 1998), only the giant Pacific octopus (*Octopus dofleini*) is commercially fished (*ibid.*). The other species are small or occupy offshore habitats although *O. rubescens* is caught as a bycatch in the shrimp trawl fishery (J. Boutillier, DFO, pers. comm.). Little or no information is available on the distribution and abundance of species other than the giant Pacific octopus. Most of the fishery has taken place on the south coast of BC, outside of the plan area, due to the proximity of processing and freezer facilities (Gillespie *et al.* 1998).

Population Size and Trends: The giant Pacific octopus is known to undergo considerable variation in abundance both month-to-month and year-to-year (*ibid.*). Populations are significantly affected by recruitment, immigration and emigration. Mortality from predation at all life history stages by fishes, marine mammals, seabirds and other octopi is also important in determining abundance (*ibid.*). There are no estimates of the absolute abundance of octopus in the plan area.

Distribution: Most octopuses are solitary, benthic animals. Some species tend to be found in deep waters (100->5000 m). In the plan area there are two species commonly found in the shallow coastal areas; the giant Pacific octopus and the smaller red octopus (*O. rubescens*). Both are found throughout the region on rocky shores and are generally solitary species (*ibid.*).

Potential Resource Conflicts: The giant Pacific octopus is commercially fished in the plan area by divers or traps. The dive fishery mostly in the southern areas while the trap fishery occurs in most coastal areas. The trap fishery is a non-directed by-catch fishery in association with the prawn and crab fisheries. Fishing is mostly limited to Queen Charlotte Strait (Planning Unit 13) although minor landings have been reported from elsewhere on the outer coast (*ibid.*). The dive fishery is currently uncontrolled and sustainable fishery levels have not been assessed (*ibid.*). Significant management changes including limited entry are being proposed for the octopus dive fishery. There is some concern over the impact on the local environment from bleach used by divers to drive the octopus from their dens, however bleach will be prohibited from use starting in 2000 (B. Atkins, pers. comm.).

Octopus is also a frequent by-catch in crab and prawn trap and in groundfish and shrimp trawl fisheries (Gillespie *et al.* 1998). Retention of octopus in these fisheries is currently allowed. Other impacts on octopus could come from human activities that affect their habitat and reduce the availability of dens. Mortality in benthic sub-adults is likely high due to predation, intraspecific competition for den sites and cannibalism (*ibid.*).

30.3.2 *5.3.2* Coastal Pelagic Fishes

The expected trends of these invertebrate populations in the absence of an LRMP have been summarised in Table 9 below.

Table 9. Expected trends of coastal pelagic fish species in the central coast plan area in the absence of an LRMP.

Species	Trend
Herring	Stable stocks subject to variability resulting from environmental influences.
Pilchard	Increasing after over-exploitation in the early 1900s. Distribution affected by water temperature.
Smelt	Status is unknown. Activities which affect local spawning habitat (intertidal sandy beaches) could have impacts upon local populations.
Sandlance	Status is unknown. Subject to fluctuations from environmental influences.

30.3.2.1 Herring

Pacific herring (*Clupea pallasi*) are important both as a source of human food and as an essential component in the complex coastal food web. Many species of marine fish, birds and mammals consume this concentrated food source, available as juvenile or adult stages or in the form or eggs or spawn. Herring spawn is especially important to certain species such as Gray whales, Bald eagles and some waterfowl species during their spring migrations or to provide energy for their own breeding. Aggregations of non-breeding herring are also an important food source for marine fish, birds and mammals.

Population Size and Trends: The Central Coast herring stock[72] contains a number of herring stocks, most of which are not subjected to a commercial fishery or considered in the annual assessments for setting fishing quotas. The area does contain one of the five major BC herring stocks (Schweigert 1998) that are fished, but this area is confined to a relatively small part of the total central coast area.

Prior to the herring roe fishery, herring catches were taken from many areas of the central coast, and all areas were open to fishing. Between 1896 and 1936, the catch from this fishery averaged 131 t and was used mainly for bait (*ibid.*). A reduction fishery expanded into the Central Coast in the late 1930s and catches averaged 35,200 t until the mid-1960s when the stock collapsed from over-fishing (*ibid.*). The stock recovered after a four-year closure (*ibid.*). The herring roe fishery began as a small experimental fishery in the early 1970's. This expanded until 1983 when fixed quotas were established and geographic limits for the fishable 'stock' were defined. Quotas for the Central Coast were set for this relatively small area. As in other areas on the BC coast, quotas are set at a fixed rate of 20% of the spawning biomass, with the condition that the minimum spawning biomass, in any year, is at least 17,600 t (*ibid.*). Spawning stock levels declined in the Central Coast in 1979 and 1980 (*ibid.*) and the fishery was closed. The stock increased rapidly and the fishery re-opened in 1981. Since 1988, the pre-fishery biomass has fluctuated at levels above 20,000 t and reached near historic levels of over 50,000 t in 1992 (*ibid.*). Recent trends show the stock declining between 1992 and 1996 and then increasing to 39,000 t in 1998 with a forecast for 43,400 t in 1999 (*ibid.*). The recent increase is thought to be due to strong recruitment of the 1994 and 1995 year-classes (*ibid.*). Charter skippers and local management staff both perceive healthy stocks with an abundance of smaller fish (PSARC Herring Subcommittee 1998).

Distribution: Pacific herring are found on the continental shelf and coastal waters of the Pacific Ocean from California north to the Bering Sea and from the western Bering Sea off Siberia south to Korea (Hourston and Haegele 1980).

Considerable attention has been directed towards the mapping and assessment of spawning and rearing areas in BC in order to identify and protect herring spawning areas. The magnitude and frequency of herring spawn has been mapped for the entire British Columbia coast. Fisheries and Oceans (DFO) has derived a spawn "index" which rates the spawn as to its importance in terms of long term production (Hay and Kronlund 1987; Hay and McCarter 1998). The index is a function of the number of layers of spawn, the extent of the spawn and the frequency of the spawn. Each area of the coast where herring spawn has been recorded has been ranked on a province-wide basis with respect to its spawn index. Within the CCLCRMP planning area, most of the locations where spawning occurs have a "index" which ranks low or moderate, relative to other spawning areas throughout the province. Locally, however, these spawning sites are important as they maintain the spatial diversity of the species (*ibid.*) and are locally important food sources for certain fish, marine mammal and bird species (e.g. salmon, eagles, Harlequin duck, Gray whales). Herring spawn is most extensive and dense in Planning Units 2, 5, and 6 (Table 10). The most significant area of spawn in the planning area is in Kitaso Bay in Planning Unit 2.

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[72] The DFO definition of the Central Coast only includes the mainland inlets and adjacent coastal areas of the planning area. However, the herring stocks in Johnstone and Queen Charlotte Straits are negligible compared to that in the area that is included in the DFO central coast.

Herring on the Central Coast generally spawn from mid-March to April although in some areas such as Burke Channel they may spawn as late as July 2 (Hay *et al.* 1989). After spawning, the adult herring move to offshore feeding banks while the newly-hatched larvae are retained mainly in nearshore waters for the first summer (Hay and McCarter 1997; Haegele 1997). Juvenile herring (ages 3-24 months) mainly remain inshore (Ware 1997). At age 2, many herring join the adults offshore sometime over the summer. Most mature and spawn for the first time at age 3 (36 months). In late winter, maturing herring migrate back inshore and over-winter in locations in the same general proximity as the spawning grounds. Fisheries occur on or close to the spawning areas – in those locations that are open for commercial fisheries (*ibid.*). The dominant age groups in the fished population are generally 3 to 7; few herring live longer than 10 years.

Table 10. Number of kilometres of herring spawn by spawn index by marine planning unit.

Spawn Index	**Marine Planning Unit**															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
<100	13.3	140	86.6	0	300	545	249	103	69.8	26.8	64.1	39.9	29.8	99.6	151	45.9
100 - <500	0	70.9	34.6	1.5	219	153	8.8	49.9	15.8	3.6	21.5	0	20.5	35.4	35.2	37
500 - <1000	0	12.9	6.2	0	24.4	4.6	0	2.2	1.7	3.5	4.4	0	2.2	0	7.8	0
1000 - <2500	0	12.7	0	0	13.8	3.3	0	0	2.2	2.4	0	0	0	0	2.4	3.7
>2500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total length	13.3	236	127	1.5	557	706	258	155	89.5	36.3	90	39.9	52.5	135	196	86.6
Relative abundance	Low	Very High	High	Low	Very High	Very High	Low	Moderate	Moderate	Moderate	Moderate	Low	Moderate	Moderate	High	High

Potential Resource Conflicts: Outside of the areas of herring fishery, the potential impacts on herring are related to destruction of spawning habitat from activities such as log storage, aquaculture and backshore activities which cause siltation. Any effect that alters the composition of macrophytes used for spawning substrate would affect herring. The geoduck and horse clam fishery that disrupts bottom habitat is not permitted in areas of herring spawn. Current siting criteria set by the BC Assets and Land Commission specify that no net-cages are allowed within one kilometre of herring spawn areas designated as vital, major or important and that for proposed sites within areas designated as sometimes important or minor, consultation with fishery managers and support biologists is required. Under the Forest Practice Code, log storage is not permitted in sensitive marine habitats. The province is in the process of currently refining the definition for "sensitive marine habitat" however any definition would have to include areas designated as vital, major or important for herring spawn. Shoreline activities which indirectly affect herring spawn habitat are not currently specifically regulated.

Oil spills can have drastic impacts of uncertain duration. Herring have been ranked at least 10 times more susceptible to oil spills than groundfish and other non-salmonids (Environment Canada 1978). The most sensitive stage is the eggs (*ibid.*). Industrial installations releasing toxic effluents can have negative, localised effects. Increased marine traffic, especially from larger vessels, may have both direct effects (by a noise-induced fright response) to indirect effects related to changes in spawning substrate caused by increased wave action. In most instances, however, herring spawning areas are not found close to major marine routes.

30.3.2.2 Pilchard (Pacific Sardine)

Three stocks of pilchard (*Sardinops sagax*) occur in the north eastern Pacific: the northernmost stock, which is centred off the California coast, moves as far north as British Columbia during their summer feeding migration.

Population Size and Trends: The northern pilchard stock supported a major fishery in the early 1900's with peak year catches of over one billion pounds in the 1930s. The stock decreased in the 1940's and collapsed in the early 1950's. The current interpretation of the collapse of northern stock is that overfishing exacerbated a decline caused by environmental change, a decade of persistently cold seawater temperatures which were unfavourable to sardine recruitment. The mechanisms responsible for the relationship between sardine recruitment and sea temperature are unknown. In 1979, about 20 years after the collapse, the northern stock showed the first signs of recovery. The stock was probably less than 10,000 mt in the early 1970s, about 20,000 mt in the mid-1980s and by 1993 was in excess of 100,000 mt, which is still a small fraction of the maximum historic spawning biomass of 3.5 million tons (Wolf *et al.* 1987). Reports from the past two years indicate that the stock is continuing to increase. The BC stock was designated a "vulnerable" species in 1987 (Schweigert 1987). The only directed fishery for pilchards in BC at the present is an experimental fishery begun in 1995 (S. McFarlane, DFO, pers. comm.).

Distribution: The northern pilchard stock breeding population is centred between Punta Eugenia in Baja California (Mexico) and Monterey, Alta California (USA). The summer feeding migration takes the fish into British Columbia and northward. Pilchards are typically found in large schools inshore. Young pilchards are found inshore near beaches. The habitat preferences of adult fish are not known.

Potential Resource Conflicts: Over-exploitation by the fishery is the main cause of the low numbers of pilchards in BC waters. Environmental factors such as water temperature are thought to affect the reproductive success of the species. There are no human activities other than fishing which are known to impact on this species.

30.3.2.3 Smelt

Population Size and Trends: There are two species of fish classed as smelt in BC, the surf smelt (*Hypomesus pretiosus prestiosus*) and the longfin smelt (*Spirinchus thaleichthys*). Populations in the plan area have not been monitored and their abundance and distribution in the region is not known.

Distribution: Smelt are known to occur in protected areas of the North Coast although they are most abundant in Georgia Strait and River and Smith Inlets. Surf smelt spawn in the summer in the upper intertidal zone of sandy beaches. Multiple spawnings within a tidal cycle and on subsequent days are customary. It is during this spawning migration when smelt are available to the fishery. Outside of the spawning season smelt may also be located offshore to 100-200 m (Lamb and Edgell 1986).

Potential Resource Conflicts: There are no commercial fisheries for smelt within the plan area although aboriginal fisheries may occur. Human activities that destroy the habitat at spawning locations could have impacts on local populations.

30.3.2.4 Sandlance

Population Size and Trends: Although the sandlance (*Ammodytes hexapterus*) is well documented as an important food for many species of marine birds, mammals and commercial fish, its local distribution and abundance is poorly known. Most of the information on this abundance of this species comes from analysis of the diet of other species such as groundfish (Westerheim and Harling 1983). While the actual abundance of sandlance has not been measured, evidence from stomach contents of groundfish indicates that the abundance fluctuates substantially from year to year (*ibid.*).

Distribution: The sandlance is a widespread species with a distribution extending from California to Alaska and across the Bering Sea to Japan. Sandlance are found from the intertidal to roughly 200 m feeding in the upper water column during the day and burying in sand substrates during the night (Hobson 1986).

Potential Resource Conflicts: Sandlance are not commercially fished in BC except for a small bait fishery. Human activities that destroy the nearshore sand habitat where the sandlance burrow could have impacts on local populations.

30.3.3 *5.3.3* Coastal Groundfish

Groundfish fisheries within the plan area are generally located in offshore areas of Queen Charlotte Sound and Queen Charlotte Strait. Most of what we know about the distribution of these species comes from the commercial trawl, longline and trap fisheries. Although the distribution of the fishery is well known based on log book data filled out by commercial fishers, this information is confidential and not available for the base case analysis.

Distribution: Information is based on published literature and interviews with fishery officers from which distributions were mapped and made available for the base case by DFO. Information on the status of stocks is discussed individually for each species of the species group. General status for groundfish species on the BC coast for the 1999/2000 fishing season is listed in Table 11, which has been extracted from the 1999/2000 DFO Groundfish Trawl Management Plan with some modification by DFO groundfish scientist Jeff Fargo (J. Fargo, pers. comm.).

Table 11. Current coastwide condition of groundfish species or species groups in BC for 1999/2000.

Species or Species Group	Current Stock Condition
Offshore lingcod	Average to low
Pacific cod	Very low
Petrale sole	Very low
Rock sole	Average to low
English (Lemon) sole	Average to low
Dover sole	Average
Sablefish	Average
Offshore Pacific hake	Average
Spiny dogfish	Average
Walleye pollock	Low to average
Slope rockfish: (includes Pacific ocean perch, redstripe, yellowmouth, rougheye, shortraker,and shortspine and longspine thornyheads)	Low to average
Shelf rockfish: (includes silvergray, widow, yellowtail, canary rockfish)	Low to average
Inshore rockfish	Low to average

30.3.3.1 Rockfish

There are at least 35 species of *Sebastes* or "rockfish" found in BC coastal waters. For management purposes, they are divided up into "inshore", "shelf" and "slope" species. Typically, inshore rockfish are caught on hook and line, shelf rockfish are harvested by trawl down to 150 m, and slope rockfish are harvested by trawl below 150 m. These designations are more for the convenience of fisheries managers and biologists rather than forming a biological distinction.

Population Size and Trends: The maximum life span of species of the genus *Sebastes* is estimated at 20-140 years depending on the species (Leaman 1991). Unfished populations are typified by a large standing stock with low rates of production. Growth and maturity do not tend to be density dependent (*ibid.*), suggesting that stocks once depleted will be slow to rebuild. Occasional "spikes" of high recruitment have been recorded but are not frequent (*ibid.*).

In all rockfish fisheries, catch is not thought to be a good indicator of abundance. Rockfish species tend to aggregate in areas of prime habitat that can be targeted by the fishery. Changes in the management of the rockfish fisheries and in the manner in which catch has been reported are also thought to bias the relationship between catch (or CPUE[73]) and stock size. For rockfishes, commercial CPUE is not used as an indicator of population status (Kronland 1997; Richards 1994).

In BC, the **inshore** rockfish species are dominated by yelloweye (*Sebastes ruberrimus*), quillback (*S. maliger*) and copper (*S. caurinus*) (Kronland 1997). Up to thirty-two other species are landed in the inshore rockfish fishery including redbanded (*S. babcocki*), rougheye (*S. aleutianus*), silvergray (*S. brevispinis*) and others (*ibid.*). The fishery uses a variety of hook and line gear from longlines to handlines. Inshore rockfish species are characterised by low productivity, longevity and low natural mortality (*ibid.*). Fishery catches in the Central coast region have generally been in the range of 1-200 t and dominated by the species yelloweye and quillback (*ibid.*). The fishery expanded rapidly from landings of 3 to 65 t between 1956 and 1985 to a catch of 145.8 t in 1986. Catches have remained high since that time. There is currently no basis upon which to judge the sustainability of removals for inshore rockfish in British Columbia (*ibid.*).

The **shelf** rockfish species are primarily composed of yellowtail (*Sebastes flavidus*), silvergray (S. *brevispinus*), widow (S. *entomelas*) and canary (*S. pinniger*) rockfish. The status of these species in the Central Coast plan area are as follows:

- Yellowtail rockfish are treated as part of a single stock (called the "Coastal" stock) which extends from central Vancouver Island to the Alaska border (Stanley and Haist 1997; Stanley 1998). Tagging studies have shown that the adult yellowtail may move long distances between British Columbia and Alaska or Washington (Stanley and Haist 1997). Landings from the Coastal yellowtail stock in BC have increased from an average of about 2800 t. from 1967 to 1986 to over 4000 t. from 1987 onwards Currently this stock appears to be declining in abundance, probably due to poor recruitment exacerbated by fishing (*ibid.*). It is unclear whether the stocks are below the average abundance for the period of exploitation (1967-present) (*ibid.*).
- Silvergray rockfish are composed of four stocks coastwide, of which the Queen Charlotte Sound stock falls into the Central Coast plan area. The total landings of this stock averaged 782 t between 1967 and 1996. The average over the past 5 years of data (1992-96) was 682 t, similar to the long term average (*ibid.*) The proportion of older fish in the catch has increased over the last ten years of landing data; this most likely indicates that the stock is not being over-fished (R. Stanley, DFO, *pers. comm.*) An alternative explanation is less optimistic of the stock status; this age distribution could also be caused by over-fishing coupled with five-ten years of poor recruitment (Stanley and Haist 1997). More information from a longer time series of catch data is needed to clarify the stock status (*ibid.*)
- Widow rockfish is treated as a single coastwide stock (Stanley and Haist 1997). Unlike other shelf rockfish species, the widow rockfish is caught by mid-water trawl and there is little biological data on the abundance or age structure of the stock which could be used to determine the stock status (Stanley 1995). However, there is no evidence to suggest that this species is currently being over-fished (*ibid.*).
- Canary rockfish are composed of two stocks coastwide, of which the Queen Charlotte Sound stock falls into the Central Coast plan area. The total landings of the Queen Charlotte Sound stock in the last four years of data (1992-95) were below the long term average of 366 t but there

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[73] CPUE stands for "Catch Per Unit Effort" which is calculated as the amount of fish caught divided by the fishing time (or some other measure of fishing effort) that it took to catch those fish..

is no biological information available to indicate that the stock is declining (Stanley and Haist 1997).

The main **slope** rockfish species include Pacific ocean perch (*Sebastes alutus*), yellowmouth rockfish (*S. reedi*), redstripe rockfish (*S. proriger*), rougheye rockfish (*S. aleutianus*), shortraker rockfish (*S. borealis*), shortspine thornyhead (*Sebastolobus alascanus*), and longspine thornyheads (*Sebastolobus altivelis*). These species are generally concentrated along the continental slope which is outside of the central coast planning area. The slope rockfish fishery has a long history, and thus far seems reasonably successful (Schnute *et al.* 1999). Analysis of heavily fished areas of the coast shows little evidence of stock depletion, except for longspine thornyheads (*ibid.*). The recent IVQ system for the trawl fishery gives the industry a long-term stake in the assets. In a worst case scenario, fish could persist in the areas of high vulnerability, while donor populations of migrant fish decline to dangerously low levels (*ibid.*).

Distribution: Most rockfish species tend to aggregate and have a high degree of fidelity to home ranges or specific habitat features (Kronland 1997). The diversity and distribution of rockfish appears to be related to both habitat and depth. For example, studies have shown that yelloweye rockfish are significantly more abundant in areas shallower than 200 m with refuge spaces (e.g. caves, large cracks, overhangs or boulder fields) (Kronland 1997). Inshore benthic species, such as quillback, copper and brown rockfishes, have been shown to have a high degree of fidelity to habitat features or to a home range (Mathews 1990; Matthews and Reavis 1990 *in* Kronland 1997).

Potential Resource Conflicts: Rockfish species are highly susceptible to over-fishing, especially in localised areas. Rockfish are taken by the commercial trawl and "hook and line" fisheries directed at rockfish species, the recreational fishery, the First Nations groundfish fishery, and by-catch from other commercial fisheries. In the central coast plan area the commercial fishery takes by far the largest portion of the rockfish and is the only fishery to be assigned an annual quota by species or species group.

Rockfish habitat is unlikely to be affected by human activities, as it tends to be in complex rocky areas typically not subject to siltation from backshore human activities such as mining or tree removal. The trawl fleet is increasingly moving onto rocky substrates and could possibly have impacts on the habitat of the species it is fishing.

30.3.3.2 Pacific Halibut

Population Size and Trends: The North American commercial fishery for Pacific halibut (*Hippoglossus stenolepis)* began in 1888 and by the 1910s, it became evident that the halibut stocks were suffering from over-fishing. Over-fishing ceased after international management commission was set up in 1923. Since the climate regime shift of 1976-77 in the North Pacific, the recruitment rate of Pacific halibut increased dramatically in both British Columbia and Alaska (Clark *et al.* 1999). Concurrently, however, the growth of individual halibut has decreased dramatically in Alaska and to a lesser extent in British Columbia[74] (*ibid.*). It is thought that decadal changes in the climate of the North Pacific are perhaps more important than density dependent factors in the life history parameters and productivity of the halibut stock although it is not at all clear what mechanisms are at work (*ibid.*).

Distribution: Pacific halibut are distributed along the continental shelf in the North Pacific and Bering Sea. Most adult fish tend to remain on the same grounds year after year, making a seasonal migration from the more shallow feeding grounds in summer to deeper spawning grounds in winter. The halibut spawn in deep water, where the eggs are fertilized. In the eastern north Pacific halibut spawn on grounds in deep water on the continental slope scattered throughout the Gulf of Alaska from the Queen Charlotte Islands to the Aleuthtian, and into the Bering Sea (Clark and Hare 1998). The major Canadian spawning sites include areas around the Queen Charlotte Islands, but spawning has also been recorded from around the Goose Islands in Planning Unit 5. In addition to these major grounds, there is reason to conclude that spawning is widespread and occurs in many areas, although not in as dense concentrations as those mentioned above. The eggs, larvae and post-larvae drift into deep currents and settle in nursery grounds in the western Gulf of Alaska (*ibid.*). The young fish settle to the bottom in shallow feeding areas or "nurseries" where they remain for two to three years. Young halibut then "counter-migrate" into more southerly and easterly waters and appear in the area of the Central Coast plan area at age four and older. By the time Pacific halibut enter the commercial fishery (at about 8 years old) most of the extensive counter-migration to balance egg and larval drift has apparently taken place. However, adult halibut migrate annually, moving to deeper depths on the edge of the continental shelf during the winter for spawning and into shallow coastal waters in the summer months for feeding. Halibut are demersal, living on or near the bottom, and prefer water temperature ranging from 3 to 8 degrees Celsius. Although halibut have been caught as deep as 1,800 feet (549 meters), they are most often caught between 90 and 900 feet (27 and 274 meters).

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[74] The weight of a halibut at a certain age is not constant, but does tend to follow a cycle. The current trend is one of decline, and fish today are smaller than fish of the same age 10 years ago.

Potential Resource Conflicts: In 1923 the U.S. and Canada signed a convention which established the International Fisheries Commission (later to become the International Pacific Halibut Commission). Since 1979, Pacific halibut in Canada has been managed under a system of limited entry to the fishery with individual vessel quotas established in 1989. The recreational fishery for halibut has probably existed for almost as long as the commercial fishery and has expanded greatly in the last 20 years as recreational fishing in the northern more remote areas of the province has increased. Currently 21 First Nations are authorized by DFO to fish for halibut to meet their food, social and ceremonial needs.

Pacific halibut first appear in British Columbia waters at age four years and older and so the younger, more sensitive life history stages are not found in the Central Coast plan area. The adults are typically found in deeper water and are unlikely to be affected to a large extent by human coastal activities other than fishing. The most significant local impacts on the halibut stocks, apart from direct fishing by the commercial, recreational and first nations fisheries, come from by-catch of halibut by vessels fishing for other species, primarily with trap, trawl and longline gear, inadvertently capture halibut (Clark *et al.* 1999). Not all halibut caught will die from the injuries if the fish is released in a careful and timely manner. To this end, many groundfish regulations deal with proper release procedures to ensure maximum survival of the fish.

Historically the majority of halibut bycatch mortality was in the trawl fishery which had an average bycatch mortality of 1.6 million pounds annually during 1990 to 1995 (Fisheries and Oceans Canada 1999). In 1995, Fisheries and Oceans Canada initiated a staged reduction of trawl bycatch mortality, first by implementing mortality limits. The current regulations allow a by-catch of up to one million pounds although the halibut fleet given individual quotas, at-sea observers and more responsible practices has independently achieved the further reduction (Marilyn Joyce, pers. comm.). Halibut bycatch mortality was reduced from 1.5 million pounds (680 metric tons) in 1995 to about 307,000 pounds (139 metric tons) in 1996, and 215,000 pounds (97.5 metric tonnes) in 1997 (Fisheries and Oceans Canada 1999).

30.3.3.3 Flatfish

In addition to Pacific halibut there are fifteen species of flatfish commercially fished or caught as bycatch in other trawl fisheries in BC waters. The species' common and scientific names along with their habitat preferences are given in Table 12.

Table 12. Regional abundance and habitat of flatfish species commercially fished in the plan area waters.

Common Name	Scientific Name	Status in Plan Area*		Habitat	
		abundance	trend	substrate	depth (m)
Starry flounder	*Platichthys stellatus*	n/a	n/a	estuaries	1-275
Arrowtooth flounder	*30.3.3.3.1.1.1.1 Atheresth es stomias*	n/a	n/a	mud	18-731
Dover sole	*Microstomus pacificus*	low	declining	mud	50-750
Butter sole	*Isopsetta isolepsis*	n/a	n/a	mud	10-366
Flathead sole	*Hippoglossoides elassodon*	n/a	n/a	mud	6-600

Common Name	**Scientific Name**	**Status in Plan Area***		**Habitat**	
		abundance	**trend**	**substrate**	**depth (m)**
Slender sole	*Lyopsetta exilis*	n/a	n/a	mud	76-512
Curlfin sole	*Pleuronichthys decurrens*	n/a	n/a	mud	7-532
Rex sole	*Glyptocephalus zachirus*	n/a	n/a	sand/mud	18-750
Sand sole	*Psettichthys melanostictus*	n/a	n/a	sand	1-183
English sole	*30.3.3.3.1.1.1.2 Parophrys vetulus*	average	declining	sand	35-125
Petrale sole	*Eopsetta jordani*	low	declining	sand	50-750
Speckled sanddab	*Citharichthys stigmaeus*	n/a	n/a	sand	0-100
Pacific sanddab	*Citharichthys sordidus*	n/a	n/a	sand	10-550
C-O sole	*Pleuronichthys coenosus*	n/a	n/a	rock/sand	1-15
Rock sole	*Lepidopsetta bilineata*	average	declining	gravel	18-55

*Stock status information from Fargo (1997) not available for all species

Population Size and Trends: There is little information on the current status and trends for most species of sole in the region. The three stocks for which there is West Coast Queen Charlotte Islands / Hecate Strait Dover sole, English sole and rock sole) are all currently declining. The English and rock sole stocks are around the long term average abundance while that of the Dover sole stock is low (Fargo 1997).

Distribution: Most species of sole in the region are found along most of the west coast from California to Alaska, however except for petrale sole migrations are limited and stocks are local. Dover sole undertake migrations to deep water to spawn. Individual flatfish species tend to have particular bottom type and depth preferences ranging from mud to rock bottom and the nearshore to over 750 m depth (Table 12) (Forrester 1969, Eschmeyer *et al.* 1983). Some species (e.g. English sole) may be intertidal as young juvenile fish and migrate offshore with age.

Potential Resource Conflicts:). Dover sole, english sole and petrale sole release their eggs into the surface waters where they are fertilised and float free to incubate and hatch in the plankton. Incubation ranges between species but is typically 7 to 20 days (Forrester 1969). Rock sole eggs are demersal and adhesive and spawning is highly localised. There may be other flatfish species with demersal eggs, such as butter sole, but there are no early life history studies for them (J. Fargo, pers. comm.). While eggs are unlikely to be impacted by human disturbance other than oil spills, juveniles and adults with intertidal and other nearshore habitat preference however may affected by habitat deterioration in inshore eelgrass beds, kelp bed or estuaries.

30.3.3.4 Walleye Pollock

Population Size and Trends: Walleye pollock (*Theragra chalcogramma*) is the most abundant fish species in the North Pacific Ocean (Bakkala *et al.* 1986). It also supports the largest single species fishery in the world with catches that exceed six million tonnes annually, mostly from Asian waters (*ibid.*). There is not enough biological information to determine the current status of this stock (Saunders and Andrews 1995, Stocker and Welch 1998).

Distribution: Four fishing areas for pollock are located in BC waters; each of these is probably an independent stock (Workman and Saunders 1991). Within the plan area fishing for pollock is located in Queen Charlotte Strait (DFO statistical area 12) and Hecate Strait (Saunders and Andrews 1995).

Potential Resource Conflicts: Walleye pollock are a widespread and abundant species in the North Pacific and human activities other than commercial fishing are unlikely to impact on the walleye pollock population within the plan area.

30.3.3.5 Pacific Cod

Population Size and Trends: Fluctuations in the stock size of Pacific cod (*Gadus macrocephalus*) are common and to be expected in a highly fecund species with a planktonic egg and larval stage. Stock status is generally derived from the catch and effort data collected from the fishery however assessments for this species have been complicated by the recent changes in management of the fishery.

Distribution: The Pacific cod is found throughout the North Pacific Ocean from southern California to the Yellow Sea however its is not commercially abundant south of northern Washington State waters. The principal areas of commercial fishing in BC are off the west coast of Vancouver Island and in Hecate Strait. Queen Charlotte Sound has a fishery of secondary importance. Commercial abundance is typically found between 18 and 130 m although the species has been found on sandy or muddy bottoms in water depths of up to 365 metres. There is a seasonal migration to the deeper waters (100-130 m) in winter months and a return to the shallower waters in spring or early summer (Forrester 1969).

Potential Resource Conflicts: Pacific cod are a short-lived, reasonably fecund species. The eggs are released and fertilised in the water column and are thought to drift to the bottom where they incubate for 10 to 17 days. Amphitrite Bank is the only known spawning grounds for Pacific cod in BC waters (Booth *et al.* 1995). There is a modest amount of movement between regions of the BC coast. Their diet is quite variable consisting of small fish (cod, sandlance, herring) and invertebrates (euphausiids, shrimp, crabs). The life history characteristics of the Pacific cod make it less vulnerable to human impacts in the plan area than other species.

30.3.3.6 Pacific Hake

Population Size and Trends: Offshore Pacific hake (*Merluccius productus*) are migratory fish that range from southern California to Queen Charlotte Sound (Dorn and Saunders 1997). Since 1968 more Pacific hake have been landed than any other species in the groundfish fishery on Canada's west coast (ibid.). Coastwide the species is treated as two stocks; there is a resident stock in the Strait of Georgia and an offshore stock which migrates from breeding grounds primarily off the California coast to offshore waters along the west coast of Vancouver Island and into Queen Charlotte Sound. Currently the stock is thought to be at moderate abundance (Dorn *et al.* 1999) having steadily declined from a record high abundance in 1986 (*ibid.*). There were no strong year classes during the 1990s and recruitment to the fishery over the next few years is expected to be low as a result (Stocker *et al.* 1999).

Distribution: Prior to 1990 the offshore pacific hake population spawned off the coast of northern California and until about the age of 3+ they remained off the California and Mexican coasts. At age 3+ the hake began an annual feeding migration northwards along the continental shelf into the coast of the north-west US and southern BC Since 1990 however, there have been significant changes in the distribution of the stock with spawning occurring at least as far north as northern Oregon and probably off the west coast of Vancouver Island. Hake tend to school near bottom or higher in the water column. Most hake are found in water depths of 200-1000 m over the continental shelf, which is offshore of the plan area.

Potential Resource Conflicts: The Pacific hake population does not breed in the plan area and its population is located primarily offshore of the plan area boundaries. Human activities within the plan area are expected to have little effect on Pacific hake.

30.3.3.7 Lingcod

Population Size and Trends: The Lingcod (*Ophiodon elongatus*) stock in Queen Charlotte Sound has undergone marked fluctuations in abundance since 1956[75] (Cass *et al.* 1990). There is no direct biological evidence on the status of lingcod stocks in Hecate Strait/Queen Charlotte Sound however the Catch-Per-Unit-Effort (CPUE) of the lingcod stock in Queen Charlotte Sound has been declining since the late 1980s and in 1995 the CPUE was the lowest it has been since 1973 (Leaman and McFarlane 1997).

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[75] 1956 is earliest date for which reliable fishing data are available

Distribution: Lingcod are found only off the west coast of North America with a range that extends from Baja California to the Alaska Peninsula with the centre of abundance off the coast of British Columbia (Cass *et al.* 1990). This species lives over rocky shores and reefs in depths of about 3-400 m although most occur in depth of 10 – 100 m in areas of strong current (*ibid.*). While some lingcod are landed from every DFO statistical area found in the plan area, there are no major commercial fishing grounds within its boundary. In BC Lingcod are most abundant in the Strait of Georgia, off the west coast of Vancouver Island and in Hecate Strait- Northern Queen Charlotte Sound. Lingcod are considered a non-migratory species; a tagging study found that after two years and most fish stay within 10 km of where they were tagged (*ibid.*).

Potential Resource Conflicts: Lingcod stocks in Queen Charlotte Sound are fished by the commercial trawl fleet although lingcod is a minor component of their catch which is dominated by rockfish. There is also a small hook and line fishery for lingcod in the region (Leaman and McFarlane 1997). Because adult lingcod move very little once they become established in an area, there is very little opportunity for lingcod to disperse from the spawning grounds. Lingcod lay their eggs in masses which adhere to rocky bottoms in high current areas with water depths of 5-60 m (Cass *et al.* 1990). The species has a generally low fecundity with roughly 26 eggs per gram body weight (100,000 to 500,000 eggs for a female of reproductive size) (*ibid.*). Spawning occurs from November to December and eggs are incubated by the male fish for an average of seven weeks (*ibid.*). Poor ventilation can lengthen the time needed for incubation and eggs need a suitable water flow (*ibid.*). The restricted dispersal of young and the restricted movements of adults means that there is very limited recruitment from other neighbouring stocks and that it is important to protect local stocks from over-fishing. Local disruption of the water flow, increased sedimentation rates or destruction of the reef habitat could effect egg survival.

30.3.3.8 Sablefish

Population Size and Trends: Coastwide in BC sablefish (*Anoplopoma fimbria*) is genetically one stock but managed as two stocks – a southern stock and a northern stock with the dividing line around Queen Charlotte Sound (Saunders *et al.* 1995). Most commercially caught sablefish are 4-35 years old but can be as old as 70 years (McFarlane and Beamish 1990). Fishing for sablefish started in the late 19th century and peaked prior to the establishment of Canada's 200 nm fishery conservation zone in 1977 (Saunders *et al.* 1995). Catch has been fairly stable since that time and biological models indicate that the stock has been reasonably stable also (*ibid.*).

Distribution: Sablefish are abundant along the coast from California to Alaska, and along the continental shelf in the Bering Sea to the coast of northern Japan at depths exceeding 200 m (McFarlane and Beamish 1983). Most adult sablefish are found at depths of between 600 and 800 m (*ibid.*) and have been caught at depths of up to 2,740 m along the continental slope to the west of the plan area (Saunders *et al.* 1995). Adult sablefish are mostly non-migratory and establishment of new stocks and genetic exchange is by movement of the juveniles and young adults (Beamish and McFarlane 1988; M. Saunders, DFO, pers. comm.). While the adult sablefish spawn offshore the 0 – 2 year age classes move inshore. Surveys have found an abundance of young sablefish (ages 3-4 primarily) in some Central Coast inlets (M. Saunders, DFO, pers. comm.). Water depth is a primary factor in controlling the distribution of sablefish in the inlets with few fish being found in areas with depths of < 200m (*ibid.*). Sablefish gradually move offshore as they increase in size and few fish over the age of 10 years are left in the inshore areas (*ibid.*; Saunders *et al.* 1994).

Potential Resource Conflicts: The commercial fishery for sablefish is closed in all inlets in the plan area. There is some bycatch of sablefish in deepwater (>200 m) hook and line and trawl fisheries (*ibid.*). Disposal of mine tailings could impact on populations however these kinds of impacts can be avoided by scientific assessment of the inlets circulation patterns prior to disposal (Waldichuck 1978).

31. 6.0 MARINE AND COASTAL BIRDS

The marine and coastal bird groups have been grouped according to their species group, distribution, breeding characteristics and behaviour of the species and their susceptibility to the various forms of human disturbance. For the most part, the discussions of species are restricted to facts relevant only for the portion of their distribution when they are in the marine environment of the Central Coast plan area.

31.1 6.1 Management Regime

Under Canada's constitution, migratory bird population management is the responsibility of the federal government while migratory bird habitat management is primarily the responsibility of the provinces. Generally, the federal and provincial governments have worked well together, and with non-governmental agencies, to conserve waterfowl and other migratory hunted species. In 1916 Canada and the United States signed the *Migratory Birds Convention*, a treaty that obliges both countries to preserve migratory birds and protect them from indiscriminate slaughter. After the passage of the *Migratory Birds Convention Act* in 1917 to implement the convention in Canada, the federal government established the agency now known as the Canadian Wildlife Service, a branch of the federal Department of the Environment, to enforce this convention and monitor migratory bird populations. However, it is only since the 1970's that there has been active and growing interest in the conservation of non-game species. The federal government has active research and monitoring programs on shorebirds, waterfowl, seabirds, and land birds and has worked through the North American Waterfowl Management Plan, Western Hemisphere Shorebird Reserve Network, and Partners in Flight-Canada to promote the conservation of all bird species. CWS is also responsible for national programs involving threatened and endangered species and international trade in endangered species. Aboriginal Canadians have growing responsibilities for the management or co-management of wildlife.

The province of British Columbia has had a branch that administers laws and regulations to protect and manage wildlife, including birds, since 1984. This branch, currently known as the *Wildlife Branch* of the Ministry of Environment, Lands and Parks, sets seasons and bag limits for game species and conducts surveys for breeding numbers of birds of concern (other than seabirds) including Bald Eagles, Peregrine Falcons and Gyrfalcons.

Provincially, marine birds may be affected by land-use proposals which may be viewed by the Wildlife Branch. Land-use may include activities ranging from forest harvesting plans and wetland drainage proposals to siting of aquaculture operations. Through referrals and working with other agencies, the Wildlife Branch tries to reduce the adverse impacts of proposed activities on birds and other wildlife via recommendations and guidelines. Birds also come under the guidelines of the Identified Wildlife Management Strategy (IWMS) which is part of the Forest Practices Code. This strategy is intended to provide guidance for managing the habitat of those species at risk that are not adequately addressed by other code provisions, such as the Riparian Management Areas and Biodiversity guidebooks.

Where it is not possible to protect marine birds through wildlife or habitat management practices, habitat acquisition is an alternative. There are a number of programs run by governments and non-governmental agencies dedicated to the acquisition and management of important bird habitats. These include the North American Waterfowl Plan and associated National Wildlife Areas and Migratory Bird Sanctuaries, Important Bird Areas and Provincial Ecological Reserves and Wildlife Management Areas.

Canada and the United States agreed to a North American Waterfowl Management Plan in 1986, an ambitious attempt to restore waterfowl populations by protecting and improving the wetlands and grasslands that ducks, geese, and swans need for breeding, nesting, and migrating. An important part of the plan is assisting landowners in managing their lands in ways that will benefit both them and waterfowl. The Canadian Wildlife Service (CWS) manages a network of National Wildlife Areas (NWA) and Migratory Bird Sanctuaries (MBS) across Canada. The Wildlife Area Regulations under the Canada Wildlife Act control activities in NWAs during all seasons, even when migratory birds are not present. There are currently no MBSs or NWAs within the Central Coast plan area.

The British Columbia Ministry of Environment, Lands and Parks may establish Ecological Reserves to protect important bird habitats. The Ecological Reserves Act was passed in 1971 and allows for the setting aside of Crown Land to protect sensitive ecosystems or species and for research and educational purposes. Within the Central Coast plan area there is one Ecological Reserve protecting marine birds; the 176 km² Duke of Edinburgh Ecological Reserve which includes the Buckle Group, and Pine, Storm and Tree Islets and the marine areas immediately around them.

31.2 6.2 Overview of Potential Resource Conflicts

There is growing evidence that since ~1990, several species of marine birds have declined dramatically off the west coast of North America (review in Burger *et al.* 1997). Our efforts to understand the impacts of humans on marine birds is compounded by global warming and periodic El Nino events which may be dramatically influencing bird abundance and seasonal distributions. The main impacts from human-related activities that are thought to affect marine and coastal birds to a greater or lesser extent include: industrial pollutants, oil spills, entanglement in nets, competition for food, hunting, introduced predators, habitat loss, and disturbance. Table 13 shows a matrix of the bird groups and the possible impacts from human-related activities and the likely trend of each group in the absence of an LRMP.

Table 13. Potential conflicts between marine and coastal bird groupings and impacts from human-related activities and expected trends in abundance on in the central coast plan area in the absence of an LRMP.

Bird Group	Trend*	Marine region of plan area used during breeding	Industrial pollution	Oil spills	Habitat loss	Entanglement	Disturbance	Competition for food	Hunting	Introduced predators
Marbled Murrelet	-	X		X		X		X		
Cassin's Auklet	0	X		X		X	X			X
Rhinoceros Auklet	+	X		X		X	X			X
Pigeon Guillemot	?	X		X		X	X			
Other Alcids	?		X	X		X		X		
Storm Petrels	-	X					X			X
Albatrosses, Fulmars and Shearwaters	?		X					X		
Glaucous-winged gull	+	X	X				X			X
Coastal gull species	0		X							
Offshore Laridae	?							X		
Black oystercatcher	-	X		X			X			X
Other shorebirds	-									
Pelagic cormorant	-	X		X		X	X			
Other cormorants	-			X		X				
Divers (loons and grebes)	-		X	X	X	X				
Waterfowl (geese, swans, ducks)	-		X	X	X				X	

Trend indicated by - = declining, + = increasing, 0 = stable

The general characteristics of these impacts are discussed below. Impacts which are specific to a species are discussed in the individual species or species group section.

- **Industrial pollutants**: Marine birds and waterfowl are contaminated to varying degrees by industrial and municipal discharges into the ocean. Chlorinated dioxin and furan contaminants from bleached-kraft pulp mill effluents were thought to be a significant factor in the reduction of breeding success of Bald Eagles and Great Blue Herons nesting adjacent to certain mills prior to 1991 (Elliot *et al.* 1989; 1996; Mahaffy *et al.* 1994). Most mills began to reduce these contaminants in the late 1980s and stricter discharge regulations came into effect on January 1, 1994.

- **Oil spills**: Catastrophic and small chronic oil spills can directly effect birds by oiling their feathers. External oiling often causes loss of buoyancy and insulation resulting in the bird drowning or dying of hypothermia. Toxic effects can result from the ingestion of oil through preening feathers. The mortality of embryos can result when eggs are oiled, especially during the early stages of incubation. The species most likely to be effected are those which spend the greatest time on the water surface such as Common murres, grebes, loons, breeding populations of alcids and wintering diving ducks. Lethal and sub-lethal effects may also result from ingestion of oil from contaminated food. While spills from large oil tankers have the most devastating impacts on marine bird populations, the probability of such a spill on the central coast is currently very low. If the current moratorium on offshore drilling is lifted this could change. Chronic oil pollution, which includes small oil spills, bilge dumping, seeps etc. are a much more frequent event in the planning area. The impact of these minor events on marine bird populations in BC is not well documented. The only method of assessing the impact from these spills is by surveying beaches for oiled bird carcasses (Burger 1993). Only two sites in the planning area have been surveyed for beached birds (Ivory Island in Millbank Sound and Egg Island off Cape Caution) (Burger *et al.* 1997). It has been estimated that the mean density of oiled birds on the BC outer coast is in the range of 0.2 birds per km surveyed (Burger 1993).

- **Entanglement in nets:** Gillnets used by the commercial salmon fishery are thought to pose the highest threat but purse seines and other types of net fisheries may also entangle and drown birds. The main species involved in net entanglement appear to be Common murres, Western grebes, Marbled Murrelets, Rhinoceros Auklets and cormorant species (Mahaffy *et al.* 1994). The entanglement of birds in nets associated with aquaculture sites has been documented on salmon and mussel farms (Rueggeberg and Booth 1989a). Species at risk from entanglement at salmon farms included cormorants, grebes, loons and diving ducks, herons and kingfishers (*ibid.*). Scoters and other diving birds (e.g. grebes) are occasionally entangled at mussel farms (Rueggeberg and Booth 1989b). The risk of entanglement at salmon farms is much lower than that posed by commercial net fisheries.

- **Competition for food:** Several marine bird species are highly dependent on certain small forage fish species including sandlance (*Ammodytes hexapterus*), northern anchovy (*Engraulis mordax*), lanternfish (Myctophidae), smelts (Osmeridae), and eulachon (*Thaleichthys pacificus*). Reduction of food through competition with fisheries directed at forage fish could significantly impact the breeding success of storm petrels, Rhinoceros Auklets, Marbled Murrelets and Cassin's Auklets. Natural changes due to oceanographic phenomena and natural population cycles confound the analysis.

- **Hunting:** Hunting is a major component of waterfowl mortality but is also the factor most amenable to management, and is regulated to keep it at a sustainable level. Poisoning by lead shot from hunting in the past was a source of mortality for bottom feeding waterfowl, such as Trumpeter Swans. Regulations have now require that copper or steel shot be used instead.

- **Introduced predators:** The introduction **of** predators such as rats, racoons and matins onto offshore islands supporting colonies can caused declines in ground nesting seabird species (Vermeer *et al.* 1997, Harfenist and Kaiser 1997). Racoons have caused serious declines in seabird colonies around the Queen Charlotte Islands (Vermeer *et al.* 1997). Black rats (*Rattus rattus*) in particular can be inadvertently introduced by vessels such as construction barges which are "infected". Rats on Langara Island, of the north coast of the Queen Charlotte Islands, have likely contributed to the disappearance of Storm Petrels, Cassin's Auklets, Rhinoceros Auklets and Tufted Puffins, and to the decline of Ancient Murrelets (Rodway *et al.* 1994). Off the coast of California (Farallon Islands) and Washington (Protection Island) the populations greatly increased when domestic farm animals (sheep and rabbits) were removed from islands supporting breeding colonies (Nettleship 1996 *in* Vermeer *et al.* 1997).

- **Habitat loss:** Increased population and the coastal development associated with it can affect coastal birds through the associated increase in boat traffic, risk of contaminated runoff, loss of estuarine and other shoreline habitats and increased disturbance from people and dogs (Burger *et al.* 1997). Estuaries, which are often important bird habitats, are also the areas most easily accessed and developed. Log booms, aquaculture sites, marinas and floating accommodations can all result in habitat loss to marine birds. Drainage of wetlands surrounding estuaries for agriculture of other human uses is another form of significant habitat loss. In the central coast planning area the effect of human disturbance is of much less significance than that found in the Georgia Basin.

- **Disturbance:** Eco-tourism can be a potential threat to nesting seabirds if the necessary education and enforcement is not in place. The spring and summer are the most popular times for boating, coinciding with the greatest nesting activity and vulnerability to disturbance. Accidental disturbance by passing kayakers increases egg and chick loss of gulls and cormorants (Vermeer *et al.* 1997) and persons landing and walking on colonies can cause considerable disturbance during the breeding season and damage and destroy nests of burrowing species such as storm petrels, puffins, auklets and Ancient Murrelets. Lights on board vessels moored near colonies at night can also pose a threat to auklets and storm petrels. Most salmon and mussel farms use some method to keep birds away from their site (Rueggeberg and Booth 1989a). The most common methods include noisemakers, dogs and guns (to scare or kill the birds) (*ibid.*). The effect of this harassment is to displace birds from these habitats. The impact of this displacement on the local bird populations is difficult to assess but could be significant in some areas (Rueggeberg and Booth 1989a; Booth and Rueggeberg 1989).

31.3 6.3 Individual Accounts for Species Groups

31.3.1 *6.3.1* Marbled Murrelet

Population Size and Trends: The Marbled Murrelet was listed as an endangered species in Canada in 1990 mainly because of loss of nesting habitat, but also because of fishing-net mortality and the threat of oil spills. Available evidence indicates that the population of Marbled Murrelets has declined and will continue to decline over most of its range (Ralph *et al.* 1995). It is estimated that there are about 45-50,000 Marbled Murrelets in BC (Rodway *et al.* 1992) which represents about 16-17% of the population in North America (Ralph *et al.* 1995). Marbled Murrelets are red-listed (threatened or endangered) provincially.

Distribution: During the breeding season, the majority of murrelets are found offshore of late successional and old growth forests. The nesting habitat is dealt with in the terrestrial base case analysis however the coastal areas used for feeding during the breeding season are also critical to the species. At this time the Marbled Murrelets are mostly located with 60 km of shore either in widely spaced pairs but in certain areas such as local mixing or upwelling areas they can form large flocks which may contain large proportions of local populations (Ralph *et al.* 1995). During the breeding season, breeding or moulting adults and hatching-year birds feed primarily on small schooling fish, notably sandlance (*Ammodytes hexapterus*) and Pacific herring (*Clupea harengus*) (Burkett 1995). The local distribution of Marbled Murrelets may be tied to areas of abundance of these small fish. Invertebrates such as euphausiids, mysids, decapods and amphipods are also component of their diet, more so in the non-breeding season. In winter the murrelets move into sheltered, protected waters such as Desolation Sound.

Within the Central Coast planning area Marbled Murrelets are mostly concentrated in the area of Princess Royal Channel and the associated fjords (Planning Unit 1), and Millbank Sound and the associated complex of Spiller-Matheson Channel (Planning Units 3, 4 and 5). High concentrations have been observed in Kynoch and Mussel Inlets at the end of Mathieson Channel in Fiordland Recreation Area. The main overwintering sites in the vicinity of the planning area are located in Desolation Sound and the south end of Discovery Passage (just south of Planning Area 15).

Table 14. Percentage of area within Marine Planning Unit with Low, Moderate and High relative abundance of Marbled Murrelets and relative importance of each planning unit to the species.

Relative Abundance	*31.3.1.1.1.1 Marine Planning Unit*															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Low	14	43	41.6	21.9	48.7	72.2	100	100	100	68.9	100	0	41	0	0	0
Moderate	57.4	27.1	39.3	20.5	29.7	27.8	0	0	0	0	0	0	6.2	30.4	16.6	0
High	23.6	0	13.7	20.3	8.2	0	0	0	0	0	0	0	0	0	0	0
Relative Importance	High	Moderate	High	High	High	Moderate	Low	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate	Low

Potential Resource Conflicts: The management of marine habitats to reduce risks of mortality from human sources is felt to be of equal importance to the management of terrestrial environments to maintain nesting habitat. Areas at sea where Marbled Murrelets concentrate are critical to the population and should be managed to reduce harm to the murrelets. The documented causes of Marbled Murrelet mortality include:

- entanglement in fishing nets. In 1980 in Barkley Sound, Carter and Sealy (1984) estimated that about 6.2% of the breeding population of Marbled Murrelets was killed in salmon gill nets. Areas of the central coast where intensive gill net fisheries overlap with Marbled Murrelet concentrations could be expected to have similar mortality rates. Moralities of Marbled Murrelets were not observed in the purse seine fishery in Barkley Sound although other species were entangled and killed (Carter *et al.* 1995). Modifications of gill net fishing methods can significantly reduce the rate of entanglement of murrelets though methods such as limiting fishing to daylight hours, modification of mesh size, and timing openings to avoid periods when Marbled Murrelets concentrate nearshore (May through July).
- capture by sport fishing gear. Sport fishermen have reported catching Marbled Murrelets on sport fishing lures (Carter *et al.* 1995). The extent of this problem is not known.
- fouling from by oil spills. Approximately 8,400 murrelets or 3.4% of the Alaska Marbled Murrelet population was killed by the Exxon Valdez spill in 1989 and about 120-150 murrelets are estimated to have been killed by the Nestucca spill off the west coast of Vancouver Island in 1988 (Carter and Kuletz 1995). Marbled Murrelets are seldom recovered in beached bird surveys (Burger 1992) indicating that chronic oil pollution is not a significant threat at this time.

31.3.2 *6.3.2* Colonial Alcids

There are three species of colonial alcid which breed and are commonly found within the planning area, Pigeon Guillemot, Rhinoceros Auklets and Cassin's Auklets. The main areas of concentration of these alcid species are found during the breeding season (April through August):

- the entrance to Queen Charlotte Strait south of Cape Caution to Pine and Storm Islands and the Buckle Group, extending westward across Cook Bank (Planning Unit 13 and the very southern portion of Planning Unit 10).
- The head of Queen Charlotte Strait where it enters Blackfish Sound (the Broughton Archipelago) (Planning Units 13 and 15).

There are also minor concentrations found in the protected waters at the southern end of Planning Unit 15 during the fall and winter months. Other colonial alcid species are also present (e.g. Common Murres and Ancient Murrelets) but they do not breed in the region and are therefor not found in such great numbers. Concentrations of Common Murres have been recorded from the Klinaklini estuary at the head of Knight Inlet (Planning Unit 16).

Colonial alcid colonies tend to be located on the outer coast, primarily on offshore islands or reefs. There are approximately 171,000 pairs of colonial alcids breeding within the plan area (Table 15). The major colonies are located in the entrance to Queen Charlotte Strait on the Buckle Group and Pine and Storm Islands (Planning Unit 13).

Table 15. Number of breeding pairs and colonies of colonial alcids in the Central Coast plan area.

Species	Pigeon Guillemot	Cassin's Auklet	Rhinoceros Auklet
Number breeding pairs:	1,648	6,815	162,240
Number colony sites:	32	5	5

31.3.2.1 Cassin's Auklet

Population Size and Trends: Cassin's Auklet is the most numerous alcid breeding on the coast of British Columbia. The total British Columbia population of Cassin's auklet is estimated at about 1,117,000 pairs on about 60 sites which represents about 80% of the world population (Campbell *et al.* 1990). There are about 6,815 breeding pairs at 5 sites within the plan area; ~6,000 of these pairs make up the colony on the Buckle group in the entrance to Queen Charlotte Strait (Planning Unit 13). Cassin's Auklet is blue-listed provincially.

Distribution: During the breeding season (March through August) Cassin's Auklets are concentrated around the colonies and the adjacent banks (Morgan *et al.* 1991). The estimated foraging range is about a 20-km (maximum 40-km) radius around the colony (Ainley and Boekelheide 1990). The majority of the birds disperse to the continental shelf in August where they probably stay and spend the winter (Morgan *et al.* 1991).

Potential Resource Conflicts: Cassin's Auklets are primarily planktivores feeding on mainly on copepods, ids and small (~40 mm) fish such as sandlance. During the breeding season (March through August) proximity of an adequate food source to the colony is critical. The auklets feed on the ocean surface in flocks, concentrating where their food is (Speich and Wahl 1980). This tendency to concentrate on the waters surface makes the species highly susceptible to oil pollution.

Cassin's Auklets are very sensitive to disturbance during the nesting period. Adults will readily desert their nests if disturbed during the incubation or brooding period (Speich and Wahl 1988). They nest in shallow burrows which are easily collapsed by people walking over the colony (*ibid.*, Vermeer *et al.* 1997) The introduction of predators such as rats and racoons onto offshore islands supporting colonies has caused documented declines in Cassin's Auklet populations in the Queen Charlotte Islands (Vermeer *et al.* 1997).

31.3.2.2 Rhinoceros Auklet

Population Size and Trends: The British Columbia breeding population of Rhinoceros Auklets is estimated at 222,800 pairs which represents over 57% of the North America population and 35% of the known world population. There are about 162,240 breeding pairs within the plan area (72% of the BC population); 150,000 of these pairs are on the Pine and Storm Islands in the Duke of Edinburgh Ecological Reserve at the entrance to Queen Charlotte Strait (Planning Unit 13). There are not many colonies of Rhinoceros Auklets in North America and most of the large ones are in British Columbia. The Rhinoceros Auklet is the most numerous alcid breeding on the coast of British Columbia.

In the 1950s only five Rhinoceros Auklet colonies were known on the Pacific coast of North America (Campbell *et al.* 1989). Since that time the species has expanded it known breeding range into Washington and Oregon and the number of known breeding sites in BC has increased to at least 30 (*ibid.*). This change could reflect more extensive surveys but could also be due to changing environmental conditions and the resulting changes in prey abundance (*ibid.*). Overall populations of Rhinoceros Auklets are thought to be increasing in BC, stable in Japan, decreasing in south-east Russia and increasing along the Pacific coast of the U.S. (Vermeer *et al.* 1997).

Distribution: Rhinoceros Auklets first appear at colonies in BC in early March (Manuwal 1984). From March until late summer the Rhinoceros Auklets in the planning area are concentrated, often in large aggregations, on the banks around their breeding colonies in the entrance to Queen Charlotte Strait. Fledging and dispersal take place in August and early September (Vermeer 1980). During the breeding season the birds forage up to a maximum of 50 km from the colony (Ainley and Boekelheide 1990). In the fall and winter months Rhinoceros Auklets disperse to the edge of the continental shelf where they probably stay and spend the winter (Morgan *et al.* 1991). Banding has shown that Rhinoceros Auklets from BC colonies disperse along the coast as far south as California and north to Alaska (Kaiser *et al.* 1984).

Potential Resource Conflicts: During the breeding season (March through August) the diet of Rhinoceros Auklets is dominated by sandlance (*Ammodytes hexapterus*); proximity of an adequate food source to the colony is critical during this period (Kaiser 1985)., The majority of the birds undergo a synchronous post-breeding moult during which the birds are flightless; the first part of the post-breeding migration is accomplished by swimming. At this time the birds are highly susceptible to impacts from oil pollution.

Rhinoceros Auklets are very sensitive to disturbance during the nesting period. Adults will readily desert their nests if disturbed during the incubation or brooding period (Speich and Wahl 1988). They nest in shallow burrows which are easily collapsed by people walking over the colony (*ibid.*, Vermeer *et al.* 1997) The introduction of predators such as rats and racoons onto offshore islands supporting colonies has caused documented declines in Rhinoceros Auklet populations in the Queen Charlotte Islands (Vermeer *et al.* 1997). Off the coast of California (Farallon Islands) and Washington (Protection Island) the populations greatly increased when domestic farm animals (sheep and rabbits) were removed from islands supporting breeding colonies (Nettleship 1996 *in* Vermeer *et al.* 1997).

31.3.2.3 Pigeon Guillemot

Population Size and Trends: It is estimated that about 9,382 Pigeon guillemots breed at 310 sites along the BC coast (Campbell *et al.* 1990); within the plan area there are an estimated 1,648 pairs of Pigeon guillemots at 32 known sites.

The breeding populations in Alaska and Washington are estimated at 46,908 and 4,270 pairs respectively (*ibid.*). There is no information on trends for this species.

Distribution: The Pigeon Guillemot breeds around the Pacific basin from the northern Asian coast to southern California (*ibid.*). It is widely distributed along the entire BC coast in nearshore waters generally along rocky coasts throughout the year. It generally avoids brackish waters and the heads of inlets. The Pigeon Guillemot tends to breed in small, loose colonies of one to 500 pairs and is probably one of the least well surveyed of the colonial alcids because of the difficulty in locating nests.

Potential Resource Conflicts: Compared to other alcid species, Pigeon Guillemot are not highly affected by disturbance, primarily because of their comparatively low nesting densities and inaccessible nest sites (Speich and Wahl 1988). They appear to appear to habituate to humans; nests have been reported on shoreline industrial sites such as ferry terminal structures (Vermeer *et al.* 1997). Breeding pairs, however, will desert their nests if they are directly disturbed during nesting or brooding (Speich and Wahl 1988).

Like other alcids, Pigeon guillemots are very vulnerable to oil pollution (Speich and Wahl 1988). They spend large amounts of time on the water in nearshore areas where oil transfer and storage is concentrated. While local populations would be severely affected, the dispersed nature of the species would likely result in a smaller impact on the population as a whole.

31.3.3 *6.3.3* Procellariiformes (storm petrels, shearwaters, fulmars, albatross)

Bird species of the Order Procellariiformes or "tube-noses" spend most of their lives at sea, coming ashore only to nest. In the plan area species which are found include the great albatrosses, shearwaters and the swallow-like storm petrels. Only the two storm petrel species breed in the plan area and so they are treated separately from the other tube-nose species. The name tube-nose comes from the external nostrils, which are encased in well-formed tubes.

31.3.3.1 Storm Petrel

Population Size and Trends: There are two species of storm petrel which are regularly found in BC waters; Fork–tailed Storm Petrel (*Oceanodroma furcata*) and Leach's Storm Petrel (*O. leucorhoa*). On the BC coast it is estimated that about 189,300 pairs of Fork-tailed Storm Petrels and 550,000 pairs of Leach's Storm Petrels breed at more than 40 sites (Campbell *et al.* 1990). Within the plan area there are an estimated 60,000 pairs of Fork–tailed Storm Petrels at three known sites and 275,000 pairs of Leach's Storm Petrels at five known sites (Table 16).

Table 16. Number of breeding pairs and colonies of storm petrels in the Central Coast plan area.

Location	Fork–tailed Storm Petrels	Leach's Storm Petrels
Buckle Group	900	25000
Pine Island	0	100
Tree Islets	8300	47000
Storm Islands	50800	191000
Reid Islets	0	11500
Fingal I.	Former colony site	0

The colonies on these islands represent a significant portion of the Canadian, and the global Fork-tailed and Leach's Storm Petrels (Table 17). The colony on Storm Island is the largest known colony in BC for both species. The breeding populations of Fork-tailed Storm Petrels in Alaska and Washington are estimated at 1,578,000 and 2,000 pairs respectively and 1,771,000 and 25,000 pairs of Leach's Storm Petrels (*ibid.*). There is no information on trends for these species. Like most sea birds, storm petrels have relatively long life spans (up to 24 years or more) and low mortality rates for their size (Speich and Wahl 1980).

Table 17. Percentage of populations of storm petrels located within Duke of Edinburgh Ecological Reserve.

Species	% total population		
	B.C	Eastern Pacific	World
Fork-tailed Storm Petrels	32	3.4	2.4
Leach's Storm Petrels	50	10	3

Distribution: Fork-tailed Storm Petrels breed around the north Pacific Ocean from the Kuriles in the west to northern California in the east (Campbell *et al.* 1990). Leach's Storm Petrel has a more wide spread breeding distribution extending in the Pacific Ocean from northern Japan in the west to Baja California in the east and in the north Atlantic Ocean from Massachusetts in the west to the British Isles in the east (*ibid.*). Both species of storm petrel are widely distributed along the BC coast, primarily in outer coastal or offshore waters. During the breeding season they usually forage within 30-50 km of the colony. The colonies are all in Planning Unit 13 and are all included in the Duke of Edinburgh Ecological Reserve which has been designated an "Important Canadian Bird Area" for this reason.

Potential Resource Conflicts: Eco-tourism poses a potentially significant threat to storm petrels if uneducated tourists come ashore on islands supporting colonies. Storm petrels readily desert their nests if disturbed by humans during incubation of brooding (Speich and Wahl 1988) and the shallow burrows of storm petrels are easily collapsed by people walking over the colony (Vermeer *et al.* 1997). Extremely unfavourable weather conditions or insufficient food may also cause petrels to temporarily abandon their nests which may result in reduced viability of eggs or death of chicks (Boersma *et al.* 1980).

Predators such as river otter also pose a threat to storm petrels on their colonies. Storm petrels are most vulnerable to oil pollution during the summer months when the birds are typically concentrated within 30 to 50 km of the colonies (Ainley and Boekelheide 1990, Alan Burger *pers. comm.*).

31.3.3.2 Albatross, Fulmar, Shearwater

Population Size and Trends: There are six other species of Procellariiformes (tube-noses) commonly found within the plan area although they do not breed in BC coastal waters (Table 18). The status of these populations within the plan area is difficult to determine as all are migrants passing through the region. The Black-footed Albatross is known to have declined drastically since the 19th century as a result of disturbance on breeding colonies (Campbell *et al.* 1990).

Table 18. Procellariiformes species commonly found but not breeding in the Central Coast Planning Area.

Common Name	Scientific Name	Breeding distribution
Black-footed Albatross	*Diomedea nigripes*	Hawaiian Is., Japan
Northern Fulmar	*Fulmarus gracialis*	Alaska peninsula to Bering Sea
Sooty Shearwater	*Puffinus griseus*	New Zealand, Australia, South America
Short-tailed Shearwater	*Puffinus tenuirostris*	SE Australia
Pink-footed Shearwater	*Puffinus creatopus*	Chile
Buller's Shearwater	*Puffinus bulleri*	New Zealand

Based on Morgan et al. 1991, Campbell et al. 1990

Distribution: These species tend to be most numerous within BC waters from April through September. All of the species tend to concentrate over offshore areas such as banks and areas of upwelling (Morgan *et al.* 1991). The most important areas of concentration within the plan area are in the waters around Goose and the Gosling Islands and over the adjacent Goose Island Bank (Planning Units 4 and 5) and at the entrance to Queen Charlotte Strait (Planning Units 10 and 13) (Burger *et al.* 1997). They tend to be mostly found offshore of the 70 to 140 m contour out to the edge of the continental shelf forming loose groups or individually (Campbell *et al.* 1990). Concentrations of Black-footed Albatross, Northern Fulmar and Sooty, Short-Tailed and Pink-Footed Shearwaters may be associated with offal discarded from fishing and processing vessels (Campbell *et al.* 1990; Morgan *et al.* 1991; Burger *et al.* 1997).

Potential Resource Conflicts: All seabirds off the BC coast face threats of both large catastrophic and small chronic oil spills (Burger *et al.* 1997). While the mortality of seabirds is generally well documented in nearshore areas, little or no information is available on offshore mortality (Burger 1992). Surveys of "beached" birds (dead birds washed up on the shore) along southern Vancouver Island shores indicates that oiling is a significant cause of mortality for seabirds (Burger *et al.* 1997)

These species are essentially surface feeders and are usually attracted to any floating object. Plastic and aluminium objects discarded at sea are cause for concern as they are picked up by the birds and ingested as food (Campbell *et al.* 1990). Other threats to the species include entanglement in drift nets and competition with commercial fisheries for forage fish. Juvenile Pacific herring are important prey for Sooty shearwater (Burger *et al.* 1997). Other important forage fish species include sandlance, northern anchovies, lanternfish, smelts and Pacific suary. The importance of fishery discards or offal to Procellariiformes species in the plan area is not known but is likely to be considerable (Burger *et al.* 1997). In the North Sea an estimated 2.5-3.5 million seabirds were supported by fishery discards (Camphuysen *et al.* 1995 and Garthe *et al.* 1996 in Burger *et al.* 1997). Changes in the fishing practices which reduce the availability of fishery waste in the plan are could impact on the distribution and abundance of these bird species.

31.3.4 *6.3.4* Laridae (jaegers, gulls and terns)

31.3.4.1 Glaucous-winged Gull

Population Size and Trends: The current BC breeding population is about 28,575 pairs (estimate in 1988 from Campbell *et al.* 1990) ; within the plan area there are 38 known breeding sites with 1,818 breeding pairs. The largest known colony in the plan area at Major Brown Rock has 319 breeding pairs or 1% of the national population, and has been designated a "Canadian Important Bird Area" because of this. Of the 37 other known breeding sites, 14 sites have less than 10 pairs, 19 sites 10-99 pairs and 5 sites have >100 breeding pairs. In Alaska the breeding population is estimated at 1333,000 pairs and in Washington it is about 18,500 pairs (*ibid.*).

During the past 50 years the Glaucous-winged Gull population in BC has increased about 3.5 times, especially near urban areas such as Vancouver (*ibid.*). Increases in the gull population is thought to be partially due to the increasing supply of human refuse (Vermeer and Devito 1989). The survival of young tends to be higher on larger colonies; predation by crows, eagles and river otter may be the primary cause of low reproductive success of solitary pairs and of small to moderate sized colonies (*ibid.*). First year mortality is thought to about 60% and Glaucous-winged Gulls seldom live to more than 15 years of age (*ibid.*).

Distribution: The Glaucous-winged Gull is widely distributed along the BC coast and is found in all coastal habitats in all seasons (Campbell *et al.* 1990). Concentrations of large numbers are found associated with spawning herring, eulachon and salmon in the spring and fall. Large spring concentrations have been recorded in all of the mainland fjord estuaries with herring and or eulachon runs. In summer, concentrations are typically small except near colonies and garbage dumps. During the winter part of the population appears to move southward along the coast; many over-winter in the Vancouver region where garbage dumps are a ready food source.

The breeding range of the species extends from northern Washing State to Alaska. The centre of distribution is Vancouver Island where 56% of all colonies are located. Within the plan area colonies are concentrated along the outer coast in Planning Units 5, 10 and 13; the main areas of concentration are at the entrances to Rivers and Smiths Inlets. There are also three small colonies in Planning Unit 15 (Table 19).

Table 19. Number of breeding pairs and colonies of Glaucous-winged Gulls by planning unit in the Central Coast Planning Area.

Planning Unit	C-5	C-10	C-13	C-15
# colony sites	9	9	16	3
# breeding pairs	329	833	637	18

Potential Resource Conflicts: Glaucous-winged Gulls are omnivorous and opportunistic in their diet. They may feed on discards from fishing vessels, small fishes, or intertidal invertebrates (Speich and Wahl 1980). They also forage at garbage dumps and on worms in flooded out fields saturated by winter rain (*ibid.*). The population is therefore unlikely to be food-limited. The species also appears to be less vulnerable to impacts from oil pollution than other marine birds which spend more time foraging on the water (*ibid.*).

Glaucous-winged Gulls primarily nest on the ground on small rocky islands, headlands or cliffs where they are highly vulnerable to disturbance while nesting. When disturbed by humans, dogs or other mammals, the gulls leave their nests unattended and eggs may become chilled or predators such as other gulls, crows, or eagles may take the chicks or eggs (Speich and Wahl 1980, Vermeer and Devito 1989).

31.3.4.2 Coastal gull species

Two small species of gull concentrate in coastal areas of the plan area during their spring and fall migrations. These are Bonaparte's Gull (*Larus philadephia*) and the Mew Gull (*L. Canus*). The migration is between nesting areas in the north-west and central interior of Canada and Alaska and overwintering areas to the south of the plan area.

Population Size and Trends: The numerical abundance of these two gull species in the planning area is not known. They both appear to be common to very common during the spring and autumn and less common during the summer months. Neither species is a coastal breeder but more into the interior where they form small colonies (*Campbell et al.* 1990).

Distribution: These two small gull species frequent bays, estuaries, lagoons and areas of high productivity such as tidal rips, upwelling areas and kelp beds. They may roost on coastal islets, log booms or over kelp beds or in other protected waters. Both species regularly are found in large flocks feeding on euphausiid concentrations, herring spawn and on juvenile salmon and other small schooling fishes. Although the main area of concentration in BC for these two species is in the Southern Gulf Islands, concentrations have been reported within the plan area. At the very south end of Planning Unit 15 along the north shore of Stuart Island, large flocks of Bonaparte's Gulls have been sighted during the spring. Other areas of notable concentrations include Port McNeil Bay and the channels amongst the islands south of Gordon Channel (Hope, Nigei, etc.) (Planning Unit 15), Fish Egg Inlet (Planning Unit 8) and the south shore of Price Island (Planning Unit 5). Small flocks (<50 birds) of these migrating gulls can be found in most of the inlets along the inner mainland coast or the north shore of Vancouver Island.

Potential Resource Conflicts: As neither species breeds in the plan area they are less vulnerable to disturbance than the Glaucous-winged Gull. Both species are surface feeders rather than divers; this reduces their vulnerability to oil spills. Locally the species would be affected by impacts on their major food sources that include euphausiids, herring and other small fishes.

31.3.4.3 Offshore Laridae

There are eight species of pelagic seabirds in the gull or Laridae family that may be regularly found in the planning area but which do not have nesting sites or colonies in the region (Table 20).

Table 20. Relative abundance of offshore Larid species found in the Central Coast Planning Area.

Common Name	Scientific Name	Relative abundance
Pomarine Jaeger	*Stercorarius pomarinus*	rare
Parasitic Jaeger	*Stercorarius parasiticus*	rare
Herring Gull	*Larus argentatus*	common
Thayer's Gull	*Larus thayeri*	common
California Gull	*Larus californicus*	rare
Black-legged Kittiwake	*Rissa tridactyla*	common
Sabine's Gull	*Xema sabini*	common
Arctic Tern	*Sterna paradisaea*	rare

Based on Morgan et al. 1991

Population Size and Trends: All of the above species commonly are found within the plan area but none breed there and all are more abundant further offshore.

Distribution: Within the plan area there are two regions where these pelagic Larids have been observed to concentrate;

- at the entrance to Queen Charlotte Strait over Cook Bank along the north shore of Vancouver Island (Planning Unit 13),
- over the Goose Bank (outer portion of Planning Unit 4)

These species are generally distributed farther offshore than the plan area boundary.

Potential Resource Conflicts: All seabirds off the BC coast face threats of both large catastrophic and small chronic oil spills (Burger *et al.* 1997). While the mortality of seabirds is generally well documented in nearshore areas, little or no information is available on offshore mortality (Burger 1992). Surveys of "beached" birds (dead birds washed up on the shore) along southern Vancouver Island shores indicates that oiling is a significant cause of mortality for seabirds (Burger *et al.* 1997)

These pelagic Larid species are essentially surface feeders and are usually attracted to any floating object. Plastic and aluminium objects discarded at sea are cause for concern as they are picked up by the birds and ingested as food (Campbell *et al.* 1990). Other threats to the species include entanglement in drift nets and competition with commercial fisheries for forage fish (Burger *et al.* 1997). The importance of fishery discards or offal to offshore gulls is not known but is likely to be considerable (*ibid.*). In the North Sea an estimated 2.5-3.5 million seabirds were supported by fishery discards (Camphuysen *et al.* 1995 and Garthe *et al.* 1996 in Burger *et al.* 1997). Changes in the fishing practices which reduce the availability of fishery waste in the plan are could affect the distribution and abundance of these bird species.

31.3.5 *6.3.5* Shorebirds

The term 'shorebird' is used here to include species of shoreline birds in the Plover, Oystercatcher, Sandpiper, Phalarope and allied families (Table 21).

Table 21. Relative abundance of shorebird species found in the Central Coast Planning Area.

Common Name	Scientific Name	Relative Abundance on BC coast*
Black Oystercatcher	*Haematopus bachmani*	Resident
Red-Necked Phalarope	*Phalaropus lobatus*	vA
Red Phalarope	*Phalaropus fulicaria*	C
Semi-Palmated Plover	*Charadrius semipalmatus*	fC-A
Black-Bellied Plover	*Pluvialis squatarola*	fC-vA
Surfbird	*Aphriza virgata*	vC
Ruddy Turnstone	*Arenaria interpres*	U-C
Black Turnstone	*A. melanocephala*	fC-A
Whimbrel	*Numenius phaeopus*	C-A
Spotted Sandpiper	*Actitus macularia*	U-fC
Wandering Tattler	*Heteroscelus incanus*	fC-C
Greater Yellowlegs	*Tringa melanoleuca*	R-vC
Lesser Yellowlegs	*T. flavipes*	R-U
Sanderling	*Calidris alba*	A
Western Sandpiper	*C. mauri*	vA
Baird's Sandpiper	*C. bairdii*	fC
Least Sandpiper	*C. minutilla*	fC-vA
Rock Sandpiper	*C. ptilocnemis*	fC-vC
Pectoral Sandpiper	*C. melanotos*	R-vC
Dunlin	*C. alpina*	C-vA
Short-Billed Dowitcher	*Limnodromus griseus*	C-vA
Long-Billed Dowitcher	*L. scolopaceus*	fC-A

*Regular occurrence (#individuals/location/day): vA= very abundant (>1000), A= abundant (200-1000), vC= very common (50-200) C= common (20-50), fC= fairly common (7-20), U= uncommon (1-6), R= rare (1-6 individuals/season) (from Campbell *et al.* 1989)

Three "shorebird" species are known to breed in the coastal region of the planning area; these include Black Oystercatcher, Killdeer, and Spotted Sandpiper. While the Black Oystercatcher nests almost exclusively on coastal spits and islands, the other two species primarily nest in inland areas of the province (Campbell *et al.* 1989).

Population Size and Trends: The shorebird species present in the planning area, with the exception of the Black Oystercatcher, are primarily non-resident. Those individuals that do reside in the planning area are at the periphery of their range. Estimation of the population and trends of species other than Black Oystercatchers was not attempted due to lack of data.

The centres of abundance of the Black Oystercatcher in BC are the west coast of Vancouver Island (30%) and the Queen Charlotte Islands (38%). The estimated BC breeding population is 1000 pairs at 320 sites (Campbell *et al.* 1989). Within the planning area, there are an estimated 91 breeding pairs at 34 sites.

Distribution: The only shorebird species for which we have reliable information on nest distribution in the plan area is the Black Oystercatcher. The species range is in the NE Pacific from northern California to Alaska. The Black Oystercatcher is a non-colonial nester, although sites with prime breeding habitat may have higher densities of nests. Prime breeding habitat is found on offshore rocks and islands. They are often found on the same offshore rocks and islands as colonial nesting seabird species. Within the planning area, nest sites are concentrated in Planning Unit 13, at the entrance to Queen Charlotte Strait (30 pairs at 12 sites). Other known nesting sites are at the southern end of Planning Unit 13 and along the outer coast in Planning Units 5 and 10 (Table 22).

Table 22. Number of breeding pairs and colonies of Black Oystercatchers by planning unit in the Central Coast Planning Area.

Planning Unit	5	10	13
# of sites	6	8	20
# of nests	18	27	46

Most shorebirds are migrants or winter visitors to the coastal portions of the planning area. The spring migration is concentrated into the months of April and May while the fall migration is spread out from mid-June to October, depending on the species. Most of the sighting data from the area does not identify the species of shorebird seen.

The sites used by migratory shorebirds are concentrated along the outer coast areas which protrude into Queen Charlotte Sound (primarily Planning Units 5 and 10). The preferred habitats for migratory shorebirds are sloping beaches and intertidal flats. Specific areas of concentration include the outer coast of Calvert Island from Cape Swain north to Boliviar Inlet (Planning Unit 5), Burnett Bay, Silvester Bay, Blunden Bay and the coast around Open Bight (Planning Unit 10). Smaller flocks of shorebirds have been reported from small bays along Queen Charlotte Strait (Planning Unit 13) and at the Klinaklini River estuary at the head of Knight Inlet . The largest flocks of shorebirds reported for the plan area are flocks of Red-necked Phalaropes in Planning Unit 13. Flocks of over 60,000 phalaropes have been sighted in Bates Passage-Goletas Channel and flocks of 3,500-4,000 birds have been reported from passages around the Broughton Archipelago and around Pine Island (Moira Lemon, CWS, pers. comm.).

Potential Resource Conflicts: The Black Oystercatcher is highly susceptible to disturbance while breeding. When the adults are frightened off the nest, the eggs or young are highly vulnerable to predation by eagles or mammalian predators such as river otters. Breeding activity can begin as early as mid-April and the young may remain around the nest until October, although most young fledge by late August (based on information in Campbell *et al.* 1989).

The beaches, tidal flats and estuaries used by migratory shorebirds during their annual migrations are important to their survival. Most of the known sites be used by shorebirds in the planning area are remote and currently have minimal human disturbance. An increase in human activity at these sites could affect e migratory shorebirds. While these shorebird species are transient in the planning area, Canada is a signatory of the migratory bird convention and is under obligation to protect the birds and their habitats.

31.3.6 *6.3.6* Cormorants

Population Size and Trends: There are three species of cormorant found within the Central Coast planning area, the Double-crested Cormorant (*Phalacrocorax auritus*), Brandt's Cormorant (*P.penicillatus*) and Pelagic Cormorant (*P. pelegicus*).

The Double-crested Cormorant is widespread in North America on both coasts, but is uncommon to rare in the plan area. This species is listed as of "Special Concern" in Canada because of threats in the Great Lakes region, however the BC population is currently expanding. This species is blue-listed (vulnerable) provincially.

Brandt's Cormorant is restricted to the Pacific coast of North America and is migrant along the outer portions of the Central Coast plan area. The species does not breed or over winter within the plan area. The population in BC has decreased recently, but numbers are known to fluctuate greatly from year to year (Campbell *et al.* 1990). Brandt's Cormorant is red-listed provincially (endangered or threatened).

The Pelagic Cormorant is the only cormorant species to breed in the Central Coast plan area. The global distribution extends from northern Alaska to Baja California and on the northeast coast of Asia (*ibid.*). There are four colony sites within the plan area with a total of 47 breeding pairs (Table 23). The *pelagicus* subspecies is red-listed provincially.

Table 23. Number of breeding pairs and colonies of Pelagic Cormorants in the Central Coast plan area.

Location	# breeding pairs	Planning unit
Buckle Group	6	13
Blenheim Is.	17	5
Dugout Rks.	18	10
Ruby Rks.	6	10

Distribution: Cormorants are not numerous within the plan area. The Pelagic Cormorant is the only species to breed in the area and remain there year-round. The Pelagic Cormorant generally tends to forage within 10 km of the breeding colony (Ainley and Boekelheide 1990). Groups of up to 40 birds have been sighted along the shores of Queen Charlotte and Johnstone Straits; generally lower numbers are found in the north plan area, typically in the sounds and channels.

Potential Resource Conflicts: The Pelagic Cormorant, like other colonial seabirds, is susceptible to disturbance by human activity while breeding. All cormorant species are diving birds that spend considerable time on the water; as such they are highly vulnerable to catastrophic or small chronic oil spills. Cormorants do not generally feed on commercial fish species and their diet is therefore unlikely to be directly affected by commercial fisheries. Cormorants have been reported as a minor bycatch in commercial shrimp trawl fisheries (Hay *et al.* 1999). The populations of small sandlance and gunnels that they do feed on appear to be greatly influenced by ocean climates that may affect cormorant feeding success and survival.

31.3.7 *6.3.7* Waterfowl and Divers

The category of "Waterfowl and Divers " has been used to include all dabbling ducks, diving ducks, swans, geese, grebes, and loons. The most common species of coastal waterfowl and divers within the planning area are shown in Table 24 below. All of these species groups breed primarily in interior regions and use coastal locations during spring and/or fall migrations or for the entire non-breeding period from September to mid-May. Three species of diving ducks, Harlequin Ducks, Surf Scoters and White-winged Scoters may move to marine waters during the late summer (July-August) to areas with high food abundance during the post-breeding moult (Savard 1988). Loons may use the marine coastal waters during the summer and dabbling ducks, geese and swans can be found in estuaries near breeding sites.

Table 24. Common species of coastal waterfowl and diving birds found in the Central Coast Planning area.

Group	Common name	Scientific name	Habitats
Swans (Cygnini)	Trumpeter Swan	*Cygnus buccinator*	Estuaries at the heads of mainland inlets or along the north east coast Vancouver Island
Geese (Anserini)	Canada Goose	*Branta canadensis*	
	Brant	*Branta bernicla*	
Dabbling ducks (Anatini)	American Widgeon Mallard Green-winged Teal Northern Pintail	*Anas americana* *A. platyrhynchos* *A. crecca* *A. acuta*	
Sea ducks – marine diving ducks (Mergini)	Harlequin Oldsquaw Black Scoter Surf Scoter White-winged Scoter Bufflehead Barrow's Goldeneye Common Goldeneye Hooded Merganser Common Merganser Red breasted Merganser	*Histrionicus histrionicus* *Clangula hyemalis* *Melanitta nigra* *M. perspicillata* *M. fusca* *Bucephala albeola* *B. islandica* *B. clangula* *Lopodytes cucullatus* *Mergus serrator* *M. merganser*	Moulting concentrations of Scoters, Goldeneye and Harlequin Ducks on the outer coast. Over-wintering ducks of all species in sheltered locations
Divers	Red-throated Loon Pacific Loon Common Loon Horned Grebe Red-necked Grebe Western Grebe	*Gavia stellata* *G. pacifica* *G. immer* *Podiceps auritus* *P. grisegena* *Aechmophorus occidentalis*	No large concentrations reported in plan area. Most common in protected to semi-protected outer coastal areas.

Population Size and Trends: There are no major waterfowl breeding grounds within the plan area. Most species of waterfowl either migrate through the region or overwinter here and return to breeding grounds in Alaska or the interior. Species of particular concern include those of which a significant portion of the world's population use the BC coast at a particular time. Over 60% of the world's population of Barrow's Goldeneye and Surf Scoter overwinter in BC coastal waters (Savard 1988). The Surf Scoter is blue-listed provincially. Almost the entire world's population of Brant migrates along the BC coast each spring, resting to feed on eelgrass in muddy tidal flats. The population of Brant has declined dramatically over the last 100 years and although the numbers have remained stable over the past 30 years, fewer birds are migrating as far north as the plan area Campbell *et al.* 1990; Belrose 1976).

The Trumpeter swan was placed on the provincial "Blue List" for 1998. The Trumpeter Swan was heavily harvested for skins in the 19th century and the once abundant population which had extended across the continent, was greatly reduced in both numbers and it range (Belrose 1976). It was considered to be on its way to extinction in 1912 (*ibid.*) but thanks to conservation efforts the population has stabilised and is estimated at about 11,000 birds (Campbell *et al.* 1990). The majority of Trumpeter Swans breed along the coast of the Gulf of Alaska and over-winter along the Pacific coast from south-east Alaska to the Columbia River. There are no known breeding locations within the planning area.

Distribution: Compared to other regions of the province, the Central Coast marine planning area is not generally an area of "prime" importance to waterfowl or divers. There are no areas within the marine region of the Central Coast planning area that have been identified as critical waterfowl habitat for BC (Hayes *et al.* 1993) although some areas have been identified by CWS as "Areas of Interest" based on use by local waterfowl populations (Burger *et al.* 1997). Notably the estuaries at the heads of some of the inlets and channels support locally important waterfowl populations. There are numerous sites in the sheltered areas of the mainland inlets and archipelagos which are also used as wintering habitat for sea ducks. Planning Units 9 (Rivers Inlet) and 16 (Knight Inlet) have the highest percentage of good waterfowl habitat in the plan area (Table 25).

Table 25. Percentage of area within each marine Planning Unit with low, moderate and high relative abundance of waterfowl and relative importance of each planning unit to waterfowl species.

Relative Abundance	*31.3.7.1.1.1 Marine Planning Unit*															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Low	87	69.9	5.3	0.9	0	0	5	0	0	0	0	0	0	0	0.2	0
Moderate	4.5	0	1.5	0	0.6	14.5	20.9	1.8	8.4	12.7	31.3	0	41.3	5	5.5	18.1
High	0	0	5.1	0	0	0	1.3	0.2	28.7	0	0	0	1.8	10	3.4	15.4
Relative Importance	Low	Low	Moderate	Low	Low	Moderate	Moderate	Low	High	Moderate	Moderate	Low	Moderate	Moderate	Moderate	High

Along the outer coast there are a number of sites that are used by post-breeding moulting sea ducks in late-July and August. It is thought that some of these sites may be traditional "moulting areas" that are used every year by the same population (Savard 1988). This moult demands considerable energy, and ducks often seek out food-rich areas where they are free from predators while flightless (Belrose 1976). Moulting concentrations of both Surf scoters and White-winged scoters have been observed within the planning area; there are currently six known sites (Table 26) however more surveys are needed to adequately describe their distribution (Savard 1988).

Table 26. Locations of known concentrations of post-breeding moulting seaducks in the planning area.

31.3.7.1.1.2 L ocation	**# of birds in concentration**		*31.3.7.1.1.3 Marine Planning Unit*
	Surf Scoter	**White-winged Scoter**	*31.3.7.1.1.4*
Darby Channel	157	0	10
Egg Rocks	18	0	10
Fitz Hugh Sound	50	0	10
Rivers Inlet	80	0	9
Spider Island	0	50	10
Troup Passage	32	0	6

Potential Resource Conflicts: Hunting is a major component of waterfowl mortality but is also the factor most amenable to management, and is regulated to keep it at a sustainable level. Other, less regulated impacts on the population within the plan area come from pollution, habitat loss and disturbance in critical moulting areas. Because of their concentrated use of estuaries and protected bays, waterfowl tend to have a greater overlap with human activities such as log dumps, marinas and parks. Waterfowl during migration and over wintering are adaptable to human presence and provided prime habitat such as eel grass beds and salt marshes are not alienated, impacts in the central coast plan area should be minimal.

32. 7.0 MARINE MAMMALS

There are three groups of marine mammals present in British Columbia coastal waters; the sea otter, pinnipeds (seals and sea lions), and cetaceans (porpoises, dolphins and whales). Historically the Steller sea cow (*Hydrodamalis stelleri*) was present in the northern Pacific including the plan area. This species was heavily hunted to extinction in the late 1700's for its meat, oil and hide. Species that are common and regular visitors to the planning area are discussed individually below in the species accounts. This is followed by a brief summary of what is known of some of the less common species that occur on the coast.

32.1 7.1 Management Regime

The Department of Fisheries is responsible for the management and conservation of marine mammals in Canada through the Fisheries Act. In the first half of this century, management of seals and sea lions in BC was aimed at maintaining populations at low levels in order to keep competition and interference with fishing to a minimum. Between 1913 and 1968, DFO managed a program of bounties, organised kills and commercial takes for meat, blubber and hides (Olesiuk *et al.* 1990; Bigg 1984). In the late 1960s concern about low numbers resulted in protection of seals and sea lions in British Columbia in 1970 (*ibid.*). Currently, salmon aquaculture operations and commercial fishermen may apply for a permit from DFO to shoot and kill seals or sea lions identified as causing a problem for them. Permits are issued on an annual basis and reasonable steps to deter or otherwise avoid problems are required (e.g. predator nets and site selection). Most salmon aquaculture operations in the province hold a permit but only a few commercial fishermen hold one (P. Olesiuk, DFO, pers. comm.).

Management of cetaceans is based on the Cetacean Protection Regulations of the Fisheries Act under which "hunting", (meaning chase, shoot at, take, kill, attempt to take or kill, or to harass in any manner), requires a permit from the Department of Fisheries and Oceans. Native people are exempted in that they may hunt any cetacean except right whales for local consumption, and hunt narwhal and beluga under separate regulations of the Fishery Act. DFO has provided guidelines for minimising harassment of cetaceans by whale watching activities but is not active in enforcement of these guidelines. The provincial government established an Ecological Reserve in Robson Bight to control boat traffic in areas of high use by killer whales, but enforcement in the area is minimal.

Whaling has been regulated by the International Whaling Commission (IWC) since 1946. The IWC is open to non-whaling nations as well as whaling nations. The non-whaling nations gradually added to their numbers on the Commission, eventually turning it from a whalers' club into a conservation-minded organisation. As a result, in 1982 the IWC was able to adopt a resolution calling for an indefinite moratorium on commercial whaling, which became effective in 1986. Canada was a member of the International Whaling Commission until 1982 but since then has only been present at meetings as an observer. In 1994 the IWC approved a *Revised Management Procedure* which allowed for the reintroduction of commercial whaling as stocks increase to certain threshold levels (54% of pre-exploitation levels). This plan was not implemented, but in 1997 the Irish Commissioner introduced a proposal which would complete and adopt the *Revised Management Procedure*; designate a global sanctuary for whales in the Antarctic Ocean; allow closely regulated and monitored coastal whaling within 200 mile zones by communities with a long tradition for such activity; but allow no international trade in whale products; and end scientific research catches. The proposal was discussed at a special meeting of the Commission in February 1998 but the Commissioners were not able to agree on it.

Canada regulates international commercial trade in cetaceans through the Convention of International Trade in Endangered Species (CITES). The majority of nations at the CITES June 1998 meeting supported sustainable use of "abundant" whale stocks by casting their votes to allow trade in whale products, 57 to 51. The poll fell two votes short of the two-thirds majority needed to lift the ban on commercial trading in whales.

32.2 7.2 Overview of Potential Resource Conflicts

Most marine mammals in British Columbia waters went through a period of heavy harvesting or directed culling up until the early 1970's. For many of these species, populations were severely reduced, but with protection from hunting some are recovering. Today, there are growing numbers of less direct but probably significant impacts that threaten marine mammals as a whole. These are incidental capture in fishing gear, marine pollution, disturbance on their breeding grounds and depletion of their food resources by commercial fisheries. At the present time the main impacts on marine mammals from human activities in BC waters are from:

- **Industrial pollutants**: Chemical and heavy metal contaminants from point sources and non-point sources may include dioxins and furans from pulp mills, PCBs, DDT, mercury, selenium and lead. As marine mammals are generally long-lived and have high fat reserves they are more likely than other species groups to accumulate contaminants. Whales are known to metabolise organochlorines more slowly than seals (Smith 1994). The impact of point source contamination in the planning area is assumed to be greater for species such as harbour seals that are year-round coastal residents in areas of contamination. The transient killer whales, which feed on seals, will also have a high potential for contamination. While there are no pulp mills or other major sources of heavy metal contamination in the plan area, contamination from sources outside the plan area may effect highly mobile marine mammals.
- **Oil Spills**: The sensitivity of marine mammals to spilled oil is highly variable. Most animals could probably avoid open ocean or small chronic oil spills. A catastrophic spill in a coastal area could have significant impacts. The species most sensitive to oil spills is the sea otter which depends on fur rather than blubber for insulation. In all species direct exposure to oil can result in conjunctivitis (Alaska Regional Response Team, Wildlife Protection Working Group 1991). Ingestion of oil may occur with those species such as sea otter which groom themselves with their mouths (*ibid.*). Ingestion of oil has been linked to digestive tract bleeding and damage of the liver and kidneys (*ibid.*). Inhalation of volatile components of hydrocarbons can result in nerve damage and behavioural abnormalities (*ibid.*).
- **Disturbance**: Animals may be displaced from traditional travel routes, haulout sites or loafing areas by disturbance caused by acoustic deterrents[76] at aquaculture sites or harassment by boat-based whale watching.
- **Killing of problem animals**: Salmon aquaculture operators and commercial and recreational fisheries may legally or illegally shoot pinnipeds perceived to be a problem.
- **Entanglement**: A survey of coastal BC fishermen in 1989 showed that two species of porpoise and one species of dolphin may become entangled in fishing gear (gillnets and seine nets). The magnitude of the problem was not estimated but most incidents occurred with gillnets (Stacey *et al.* 1990). There have been two reports of a young humpback whale entangled and killed in impoundment's set up for spawn-on-kelp operations on the west coast of Vancouver Island (E. Lochbaum, DFO, pers. comm.).
- **Collision with ships**: Collision with ships is an infrequent source of mortality for some marine mammals. Collisions with subsequent moralities have been reported for both Gray whales (Hill 1999) and Fin Whales (E. Lochbaum, DFO, pers. comm.).
- **Competition for food**: It is thought that some marine mammal populations may be changing their distributions or declining partially in response to reduction of food through competition with fisheries directed at forage fish[77].

Table 27. Potential conflicts between marine mammal groups and human activities.

Species	Trend*	Industrial Pollution	Oil spills	Disturbance	Killing of Problem Animals	Entanglement	Competition for Food
Sea otter	+	X	X				X

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[76] Devices that generate underwater sounds with a frequency in the range of maximum hearing sensitivity of seals and sea lions with a typical intensity of about 200 dB which can cause pain to marine mammals (Iwama *et al.* 1997).

[77] small schooling fish species such as herring, sardine, sandlance or anchovy which are an important food source for marine wildlife

Species	Trend*	Industrial Pollution	Oil spills	Disturbance	Killing of Problem Animals	Entanglement	Competition for Food
Harbour seal	0	X		X	X	X	
Steller sea lion	+	X		X	X	X	X
Killer whale	-	X		X			X
Pacific white-sided dolphin	0					X	
Dall's porpoise	?					X	
Harbour porpoise	-	X		X		X	
Humpback whale	-			X		X	
Gray whale	-		X	X		X	

Trend indicated by - = declining, + = increasing, **0** = stable

32.3 7.3 Individual Accounts for Species-Groups

32.3.1 *7.3.1* Sea Otters

Population Size and Trends: Early in the eighteenth century, the range of the sea otter extended from coastal regions of California, up the North American west coast, across the Aleutian Islands and into coastal regions of the western Pacific as far south as Japan. Sea otters were intensively hunted throughout their range from the 1740's to the 1850's resulting in near extinction (Watson *et al.* 1997). The species was given protected status in 1911, but the British Columbia population had already been extirpated. The population is recovering and the growth rate of the population is estimated to be 18-20% (a doubling time of about 4 years). In 1995 a minimum of 1522 sea otters were found in BC and the world-wide population is thought to be about 150,000 animals (Watson *et al.* 1997). Most of the sea otters In BC are located off the west coast of Vancouver Island. One group of about 135 sea otters has been located in the planning area, concentrated in the Goose Island Group within the Hakai Recreation Area. While the sea otters off the west coast of Vancouver Island are known to have originated from eighty-nine individuals reintroduced into Checleset Bay on the west coast of Vancouver Island from 1969-72 (MacAskie 1987), the origin of the Goose Island Group population is unknown. Sea otters are red-listed provincially.

Distribution: Sea otters in the Central Coast planning area have been mapped from directed surveys for the species in the Goose Island Group. There have been not been any sightings of sea otter concentrations in any other part of the region. While their distribution in the region presently appears to be restricted, it is anticipated that it will continue to expand as the population increases. Sea otters find their food primarily on the bottom and are generally found in depths of not more than 20 fathoms. They are highly adaptable in their diet and feed on sea urchins, clams, mussels, crabs and fish (MacAskie 1987). By feeding on herbivorous invertebrates, particularly sea urchins, sea otters reduce grazing pressure and increase the growth and abundance of fleshy brown algae such as kelp (Watson 1993).

Potential Resource Conflicts: The greatest threat to sea otters is from oil spills. Sea otters rely on their fur for insulation and direct oiling of even a small part of their fur may result in rapid death from hypothermia (Alaska Regional Response Team, Wildlife Protection Working Group 1991). Sea otters groom their fur frequently which may result in ingestion of oil, leading to damage of internal organs (*ibid.*). Sea otters are sensitive to disturbance by humans, particularly females with pups, however they tend to avoid humans and we do not know what impacts might be expected from increased tourism in their core area (the Hakai Recreation area) (J. Watson, pers. comm.). Other human-related threats to sea otters include local concentrations of environmental toxins, conflicts with shellfish fisheries and incidental entanglement in net fisheries (Watson *et al.* 1997).

32.3.2 *7.3.2* Harbour Seals

Population Size and Trends: Harbour seals are by far the most abundant marine mammals in BC coastal waters. The species was heavily culled under a DFO program until the early 1970's to reduce perceived conflicts with commercial fisheries. The British Columbia population as a whole is estimated to have increased at a rate of about 11.9% per annum during the 1970's and 1980's, but in the mid-1990s the rate slowed to about 7.2% (Olesiuk 1998) and currently it is close to 0% (P. Olesiuk, DFO, pers. comm.). The current population is estimated at 124,000 harbour seals (Olesiuk 1998).

Distribution: Seals have been surveyed in some areas of Johnstone Strait/Queen Charlotte Sound but most of the plan area has not been surveyed. Harbour seals are non-migratory and tend to show high site fidelity to specific haulout sites. On the central coast, pupping occurs between May and June (Olesiuk and Bigg 1988). Pups are nursed from 3 to 6 weeks. Harbour seals spend significantly more time hauled out between August and February than in other months which coincides with moulting and the growth of new pelage (Cottrell 1995). Pacific hake and herring constitute the main diet, and comprise 42.6 and 32.4% respectively of seal diets in the Strait of Georgia (Olesiuk *et al.* 1990).

Potential Resource Conflicts: Harbour seal predation on farmed salmon is considered a serious problem by many BC salmon farmers, and where authorised by the Department of Fisheries and Oceans, persistent harbour seals that can not be deterred by non-lethal means are shot by farm operators (Ruggeberg and Booth 1989a). DFO records of reported kills show that about 100-200 marine mammals (harbour seals and sea lions) were killed by salmon farm operators each quarter in recent years, with the highest number killed during the October to December quarter (Iwama *et al.* 1997). The majority of these are harbour seals, but the impact of mortality from conflicts with salmon farmers is probably not significant to the health of the overall population in British Columbia. However, harbour seals are generally localised in their movements (Harvey 1987 cited in Calambokidis *et al.* 1997b) and the impact on local populations at haulouts in the vicinity of salmon farms could be significant. Harbour seals also have significant interactions with commercial and recreational fishermen (Olesiuk and Bigg 1988) and an unknown number are killed by fishermen each year (P. Olesiuk, DFO, pers. comm.). Abandonment and subsequent mortality of harbour seal pups may result from disturbance to breeding sites while the pups are small.

Adult harbour seals have a thick blubber layer and do not groom their fur, which makes them less sensitive to the effects of an oil spill. Harbour seal pups are probably more sensitive as they have little or no blubber at birth and rely on a fur coat for insulation.

32.3.3 *7.3.3* Sea Lions

There are two sea lion species within the planning area, Northern or Steller's (*Eumetopias jubatus*) and California (*Zalophus californianus*) sea lions. California sea lions do not breed in British Columbia waters. Their main breeding grounds are in the waters of California and Mexico (Bigg 1985). Northern sea lions are found from California to the Bering Sea and Japan, and breed throughout their range (Bigg 1985). Both species were hunted throughout their range until the late 1960's.

Population Size and Trends:
California Sea lion: It was not until the mid 1960s that California sea lions began to appear regularly off southern Vancouver Island during the non-breeding season in late-fall and winter months (Olesiuk 1996). Only the males migrate into BC waters and until recently they did not come as far north as the waters of the plan area (*ibid.*). Since 1998 California sea lions have become relatively common in the southern portion of the plan area, and are now thought to migrate as far north as Alaska (G. Ellis, DFO, pers. comm.). This northward movement is thought to possibly be in response to a northward shift in the migratory herring populations and a dramatic increase in pilchard stocks in northern BC The wintering population in BC is estimated at 2,500 – 3,500 animals (Olesiuk 1996).

Northern sea lion: Between 1913 and 1968 DFO sponsored a population control program for Northern sea lions in response to complaints of commercial fishermen of the damage done by this species to commercial fish and fishing gear. The control program involved organised kills, bounties and a commercial fishery for the meat, hide and blubber. It was estimated that the population decreased from an estimated 10-11,000 sea lions in 1913 to 5-6,000 sea lions in the mid-1960s. The population has been slow to recover and the last published census in 1988 put the population at about 7,000 animals, including pups (Olesiuk and Bigg 1988). The breeding population of Northern sea lions in British Columbia in 1984 was estimated at 4000 animals (Bigg 1985). The BC population of Northern sea lions appears to be increasing at a rate of approximately 1-3% per annum (Olesiuk 1996). In contrast, populations in Alaska have recently gone through a period of drastic decline (Smith 1994). Off the coast of Alaska, the population of Northern sea lions was estimated at 140,000 in 1960, 68,000 in 1985, and 25,000 in 1989. Thus the population has declined by 82% since 1960. The sharpest declines were seen in the Eastern Aleutian Islands, where the count dropped from 50,000 to 3,000. The declines are spreading to previously stable areas and are accelerating. If they continue, this species will be extinct in the eastern Aleutian islands by the end of the decade and in the Gulf of Alaska shortly thereafter (Bryant 1998). The declines are thought to be due to depletion of the sea lions' food supply by the Atka mackerel and pollock fishery in the Bering Sea / Gulf of Alaska. Harbour seals are also declining, probably for the same reason (*ibid.*). In 1997 the National Marine Fisheries Service listed the western Alaska population of Northern sea lions as 'endangered', with the eastern population (south-eastern Alaska to California) remaining classified as 'threatened'. The Northern sea lion is included on the provincial red list (threatened or endangered).

Distribution: The Northern sea lion occurs along the coastal rim of the North Pacific Ocean from California to the Bering Sea and the Kurile Islands. It is a year-round resident of BC waters and tends to concentrate in specific traditional sites (haulouts). Although juveniles have been found up to 1,500 km from their place of birth, adults tend to be non-migratory. The species tends to remain within a few kilometres of shore but they are occasionally seen as far as 130 km offshore feeding on the continental shelf. Their distribution is probably tied to that of their main prey species, pilchard, Pacific hake, Pacific herring, walleye pollock and spiny dogfish.

During the breeding season (between late May and early August), the majority of Northern sea lions are distributed among 5 large breeding rookeries located on the edges of the planning area on the Scott Islands, Cape St. James and North Danger Rocks. Two former rookeries were located within the planning area at Isnor and Watch Rocks. Isnor Rocks was abandoned in the mid-1960s and Watch Rock was probably abandoned during the intensive kills on the Sea Otter Group between 1913 and 1915.

At the end of the breeding season, animals disperse from these sites to a large number of specific winter haulout sites. Most of the major haulouts are known and mapped in the planning area. The major haulouts in the planning area are located on offshore islands in Queen Charlotte Sound and outer Queen Charlotte Strait in Planning Units 4, 5, 10 and 13. Concentrations of rafting sea lions have been observed near the major salmon runs and areas of herring spawn at the head of Knight Inlet (unit 16) and Kingcome Inlet (unit 14). Sea lions are known to concentrate around areas of major herring spawn or large schools of pilchard. Animals begin to arrive at winter haulouts in October and peak numbers of animals are counted between January and March, after which animals begin to disperse to the breeding rookeries (Bigg 1984).

Potential Resource Conflicts: Sea lion predation on farmed salmon is reported, although it seems to occur less frequently than with harbour seals (Rueggeberg and Booth 1989a). Sea lions are killed by farmers where persistent animals can not be deterred (Iwama *et al.* 1997). Commercial and recreational fishermen commonly harass sea lions (e.g. with seal bombs) and occasionally kill them. The impact, if any, to the population from these sources of harassment and/or mortality is not known. Competition with or direct interactions with commercial and recreational fishing may also be significant (Olesiuk and Bigg 1988). Northern sea lions breed at sites within the planning area and may be affected by disturbance to breeding sites while the pups are small.

Adult sea lions have a thick blubber layer and do not groom their fur that makes them less sensitive to the effects of an oil spill. Steller sea lion pups are probably more sensitive as they have little or no blubber at birth and rely on hair for insulation, however there are no rookeries currently in the plan area.

32.3.4 *7.3.4* Cetaceans

Cetacean (whale, dolphin and porpoise) species are very mobile and there is limited sighting data for most species and areas. The distributions of the more common whale species in the planning area have been mapped using habitat models based on water depth range and distance from shore preferences for each species. Where sighting data was available it was used either to map the degree of use (high, medium, low) and/or to verify the habitat models. The distributions of killer whales, Gray whales, humpback whales, Pacific white-sided dolphins, Dall's porpoise and harbour porpoise were mapped in this way.

Blue, fin, humpback, sei and sperm whales were seriously depleted by commercial whaling in BC waters between 1905 to 1967. Offshore pelagic whaling by foreign vessels no doubt also contributed to the decline as well. Right whales and

Gray whales were already commercially extinct in the North Pacific by the early 1900s although they did not receive formal protection from whaling until 1935 and 1937 respectively (Small 1971). No Gray whales and only a handful of right whales were ever taken in the history of BC coastal whaling, a clear indication that few animals remained.

The following individual species accounts outline the known characteristics and potential threats which are unique to each of the key cetacean species.

32.3.4.1 Killer Whales

Population size and Trends: There are three distinct communities of killer whales that occur in the Central Coast planning area: northern resident, transient and offshore. These forms are distinguishable from each other by differences in behaviour, social organisation, morphology and genetics and there is little or no interaction among the communities even though portions of their ranges overlap (Ford *et al.* 1994). The northern resident killer whale community currently consists of 214 animals (Ford *et al.* 2000). Resident killer whales travel in cohesive groups of related individuals called pods and there are 16 such pods in the northern resident community. All of the 16 pods of the northern resident killer whale community occur in the planning area (Ford *et al.* 1994, Ford *et al.* 2000). Transient killer whales travel in less stable associations of 1 to 7 individuals. There is less certainty as to the size of the transient killer whale population but a total of 215 individuals have been identified in coastal waters to date (Ford and Ellis 1999). The size, social organisation, diet and distribution of the offshore killer whale population is largely unknown. They seem to travel in large groupings, as most sightings are of groups of 30 to 60 individuals. They are believed to originate from offshore regions and the reason for their infrequent forays onto coastal waters are unknown. Over 200 individual animals have been identified since 1989 (Ford *et al.* 2000). The resident, transient and offshore ecotypes are all included on the provincial blue list.

Distribution:

Resident Killer Whales: Resident killer whales feed extensively on salmon and their movements are driven to some extent by the movements of the salmon (Nichol and Shackleton 1997). In the spring and early summer, resident pods have been observed in Caamano Sound and Fitz Hugh Sound as well as near Bella Bella and Bella Coola and their occurrence in these areas coincides with the arrival of early runs of salmon. By mid to late summer, resident pods are observed frequently in Queen Charlotte Strait and Johnstone Strait, to the south, where they feed on huge runs of salmon returning to the Fraser River, however there is still some movement of whales to and from the central coast. The consistent seasonal occurrence of resident killer whales in the area between the south end of Queen Charlotte Strait and the north end of Johnstone Strait supports a significant whale watching industry. A unique attraction to whale watching in the area is Robson Bight (Michael Bigg Ecological Reserve), in Planning Unit 13. Here, resident killer whales come into shallow water to "rub" on the smooth pebble bottom and the area has been established as an ecological reserve to protect this habitat. There are likely other, less well-known rubbing beaches within the planning area, for example along the gravel shore at Pultney Point on Malcolm Island (also Planning Unit 13).

On the central coast, there are few areas where resident killer whales have not been reported (Table 28). Consistent sightings have been observed in Dean and Burke Channels and the prime north-south travel routes appear to be by way of Laredo Channel (Planning Unit 2 and 4) and the outside passage. In Milbanke Sound (Planning Units 4 and 5) there is considerable cross-channel movement, particularly through Seaforth Channel and in Queen Sound; movements into Fitz Hugh Sound are through Hakai Passage in the Hakai Pass Recreation Area (Planning Units 5 and 10).

Table 28. Percentage of area within Marine Planning Units with low, moderate and high relative abundance of resident killer whales and relative importance of each planning unit to the species.

Relative Abundance	Marine Planning Unit															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Low	0	0	0	0	0	0	13.2	0	17.7	1.5	96.7	70.1	0	0	20.6	65.4
Moderate	91	91.9	52	100	91.9	12.7	0	0	0	88.8	0	2.4	70.4	81.3	64	29.2
High	0	0	0	0	4.7	29.3	79.9	86.7	55.3	8.9	0	0	27.6	0	10	0
Relative Importance	Moderate	Moderate	Moderate	Moderate	High	High	High	High	High	High	Low	Low	High	Moderate	High	Moderate

Offshore Killer Whales: Sightings of offshore killer whales are very limited at this point and there is not enough information to infer their distribution. The sightings that have been made within the planning area have been in Johnstone Strait and Queen Charlotte Sound but most sightings are from the Queen Charlotte Islands and 15km or more off the west coast Vancouver Island along the continental shelf (Ford *et al.* 1994).

Transient Killer Whales: Transients hunt seals, porpoise, dolphins, sea lions and even baleen whales and are sighted throughout the planning area. Unlike resident killer whales, there is no obvious seasonal pattern to the occurrence of transients, although there may be some tendency to investigate harbour seal haulouts more during the pupping season (Baird 1994).

Potential Resource Conflicts: There have been numerous studies directed at studying the impacts of the whale watching industry on resident killer whales (Briggs 1991; Johnstone Strait Killer Whale Committee background report 1991; Kruse 1991; Wong *et al.* 1991). The whales' respiration rates increase when numerous boats closely follow them. Harassment from concentrations of the fishing fleet are also of concern. Resident killer whales are highly sensitive to disturbance at rubbing beaches. Local education programs have worked to inform people about how to behave around whales. Ford has noticed that as whale watching tours grow steadily in popularity each year, boat noise becomes a significant factor in whales' responses and movement, and is just as important to monitor as the whales' vocalisations themselves. Ford believes that noise from boats may interfere with the whales' underwater communication. Noise pollution may prevent echolocation and communication which could diminish the whales' abilities to find food.

The potential impact of acoustic deterrent devices (ADDs) used at salmon farms on killer whales is not known although the frequency range of the ADD signal is certainly within the range of killer whale hearing (Haller and Lemon 1994; Hall and Johnson 1972). There is evidence that mortality of killer whales in south east Alaska occurred as a result of the Exxon Valdez oil spill (G. Ellis, DFO, pers. comm.). Oil spills would likely have to be on a large scale in a confined space (as the Valdez spill was) to cause mortality of killer whales. High levels of organochlorines and heavy metals have been measured in the tissues of both resident and transient killer whales in BC, however, effects on the health of the population have not been determined (Ross 1998).

32.3.4.2 Gray Whales

Population size and Trends: Gray whales were hunted to near extinction by 19th century coastal whalers in California and Mexico. No Gray whales were caught by BC coastal whalers between 1905 and 1937, which suggests they were rarely encountered. Gray whales received protection from coast whaling in 1937. Since then, the north-east Pacific population has recovered to pre-exploitation levels and the 1997/98 population size was estimated to be 26,635 whales (Rugh *et al.* 1999). Between 1967/68 and 1995/96 the north-east Pacific population increased 2.5% per annum (*ibid.*). Approximately 150 to 200 animals are still taken annually for local consumption by Soviet aboriginal peoples and a further ten, at most, are taken annually by native people in Alaska (*ibid.*). As a result of the successful recovery of this population, Gray whales have been removed from the endangered species list (*ibid.*).

Distribution: Gray whales breed in lagoons in Baja California in January and February. Following breeding they travel northward and typically appear along the outer BC coast in March (Darling 1984). Almost the entire north-east Pacific population migrates through BC coastal waters but many animals do not make the entire migration to the Beaufort and Chukchi Seas. A portion of the population summers in the Strait of Juan de Fuca, Strait of Georgia, Queen Charlotte Strait, along the east and north coasts of the Queen Charlotte Islands and along the central and north mainland coast. Here they presumably find sufficient food to sustain them until November when they return south to Mexico. An estimated 35 to 50 animals summer along the west coast of Vancouver Island (Darling 1984) and the whale-watching industry there relies on these animals. The number that summer on the central coast is not known, but coast wide there are probably about 150 resident animals between March and November (G. Ellis, DFO, pers. comm.).

Within the planning region, the greatest concentrations of migrating Gray whales occur in Planning Unit 13 along the north-east coast of Vancouver Island from Malcolm Island northwards (Table 29). Concentrations also occur along the outer mainland coast from Rivers Inlet south past Cape Caution to the Southgate Group (Planning Units 10 -13). Gray whales probably also occur to the north, along shallow exposed shores within the planning area.

Table 29. Percentage of area within Marine Planning Units with low, moderate and high relative abundance of Gray whales and relative importance of each planning unit to the species.

Relative Abundance	Marine Planning Unit															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Low	2.8	7.3	20.2	0.1	1.5	20.8	1.1	7.9	0.4	5.9	37.5	26.1	5.4	36	32.8	10.6
Moderate	7.2	15.7	2	0	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	4.5	0	1.5	20	0.6	0.3	0
Relative Importance	Moderate	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Moderate	Low	Moderate	High	Moderate	Moderate	Low

Gray whales feed on a variety of different prey inhabiting a variety of different nearshore, shallow habitats. They seem to prefer water depths of no greater than 40 m (Green *et al.* 1992) and should be expected to occur along shallow (3-50 m) exposed shores within the study area. In areas with soft sediments and an abundance of sediment-dwelling invertebrates, Gray whales scoop mouthfuls of sediment from the bottom, straining the mud through their baleen. In nearshore rocky areas, Gray whales feed on clouds of mysids. Gray whales feed on the dense accumulations of roe when herring spawn in nearshore areas in spring.

Potential Resource Conflicts: Gray whales are probably more susceptible than other whales to impacts of catastrophic oil spills because of their nearshore feeding habits. Collisions with boats and entanglement in fishing gear are reported to occur in California waters (Reeves and Mitchell 1988), but are not documented in this region. The hearing range of the Gray whale is not known, however some concern has been raised about the effect of ADDs (Iwama *et al.* 1997).

32.3.4.3 Humpback Whales

Population size and Trends: All stocks were heavily exploited in the 19th and early 20th centuries. Between 1905 and 1965, 5,574 humpback whales were caught in BC. After 1965, humpback whales were at last afforded protection from whaling by the International Whaling Commission, but recovery of the population has been slow. Even as recently as 1982, the North Pacific humpback whale stock was assigned "Threatened Status" by COSEWIC (Whitehead 1987). It is estimated that by 1965, the North Pacific stock had been reduced to 850 animals from a pre-exploitation level of 15,000 (Rice 1978, cited in Whitehead 1987). The most recent population estimate, based on photographic mark-recapture, is 8,000 animals in the North Pacific (Calambokidis *et al.* 1997a). This estimate is significantly higher than previous estimates of 2,000 animals (Whitehead 1987).

Distribution: The eastern North Pacific stock breeds during December to February in the waters around Hawaii and off the west coast of Mexico. The animals then migrate to northern feeding areas in March, where they feed until the late fall. Their summer range extends from southern California to the Chukchi Sea with concentrations in SE Alaska.

Historically, BC whalers caught them along the west coast of Vancouver Island and the Queen Charlotte Islands, in Dixon Entrance, Hecate Strait and even in Queen Charlotte Strait off north eastern Vancouver Island and in the numerous adjoining passages of the Broughton Archipelago. Humpback whales, though certainly not has abundant now as they once were, are becoming an increasingly common sight in BC waters. They are a coastal species and enter inlets and channels, though probably avoiding water depths of less than 10 metres, to feed on euphausiids and small schooling fish. Incidental sightings suggest they should be expected throughout the waterways of the study area, as well as in a few key areas where they have been consistently seen over many years. These include Fitz Hugh Sound (Planning Unit 8), Fisher Channel (Planning Unit 7), Rivers Inlet (Planning Unit 9), Queen Charlotte Sound (Planning Unit 10 and outer portion of unit 11) and Queen Charlotte Strait and the Broughton Archipelago (Planning Unit 11). Humpbacks have also been sighted in Kingcome and Knight Inlets (Planning Units 14 and 16) and in Johnstone Strait as far south as Port Neville (Planning Unit 15) (Table 30). Incidental sightings of humpback whales in BC waters suggest that, after Gray whales, humpbacks are perhaps, the most frequently encountered of the large baleen whales (J. Ford unpubl. data; K. Morgan unpubl. data).

Table 30. Percentage of area within Marine Planning Units with low, moderate and high relative abundance of humpback whales and relative importance of each planning unit to the species.

Relative Abundance	Marine Planning Unit															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Low	1.1	1.6	0	0	0	0	75.2	0	0	0	0	0	0	0	11	0
Moderate	91	90.3	96.3	100	99.4	98.4	0	3.4	0	48.7	0	0	50.9	35.4	0	0
High	0	0	0	0	0.1	1.1	19.1	87	53.3	27.8	28.6	0	6.7	44.5	53.2	93.3
Relative Importance	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	High	High	High	High	High	Low	High	High	High	High

Potential Resource Conflicts: Entanglement in fishing gear is a well-documented problem along the coast of Newfoundland (Whitehead 1987). Incidental reports in BC suggest that it does occur but the severity of the problem is not known. Recently concern has been raised about the impact of acoustic deterrent devices (ADDs) used at salmon farms to deter harbour seals. A decline in sightings of minke whales, Gray whales and humpback whales in the Broughton Archipelago coincided with the introduction of ADDs at farm sites in the area. Although a causal relationship between these two events has not been demonstrated, these observations should not be dismissed (Morton 1996 cited in Iwama *et al.* 1997).

32.3.4.4 Pacific White-sided Dolphins

Population Size and Trends: There are no reliable estimates of the population of this species in the North Pacific, although it is generally believed to be one of the most abundant species. Estimates range from 50,000 to over 6 million (reviewed in Heise 1996). Although there seems to be little consensus on population size, Heise (1996) estimated a number of population parameters and concluded that the population is likely stable.

Distribution: Pacific white-sided dolphins are one of the most widely distributed dolphin species in the North Pacific. They are encountered in huge schools of up to 1000 individuals, although schools of 100+ may be more common (Leatherwood and Reeves 1983). They occur well offshore but also over the continental slope and shelf and even in protected coastal waters. In recent years, there has been a notable increase in sightings of Pacific white-sided dolphins in the protected coastal waters of British Columbia. The inshore occurrence of large schools of dolphins would have been rare ten years ago in BC. When they did occur it was typically in the fall, winter or early spring. During the 1990s Pacific white-sided dolphins became a common sight on the central coast and season was longer a predictor in their occurrence. Sightings were common in Johnstone Strait north of Port Neville, the Broughton Archipelago, Queen Charlotte Strait, Goletas and Gordon channels, Fitz Hugh Sound, Burke, Dean and Labouchere channels, and Lama Pass (see Table 31). Concentrations might be sighted within almost all parts of the northern planning area. Groups sighted in

BC have ranged between 1 and 1000 animals with a mean of 62 (Stacey and Baird 1991). Information on depth preferences of Pacific white-sided dolphins is sparse. They feed primarily on cephalopods and small schooling fish which occur as deep as 1000 m (Kajimura *et al.* 1980; Stroud *et al.* 1981) and it is thought that they probably do not occur in depths less than 20 m (G. Ellis, DFO, pers. comm.; Stacey and Baird 1991). Recently (1999/2000) sightings of Pacific white-sided dolphins in the central coast have become much less common (G. Ellis, J. Ford, pers. comm.). It is not yet known if this is s temporary or long term change in distribution.

Table 31. Percentage of area within Marine Planning units with low, moderate and high relative abundance of Pacific white-sided dolphins and relative importance of each planning unit to the species.

Relative Abundance	Marine Planning Unit															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Low	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	84.8
Moderate	75.3	63.1	4.5	65.6	44.5	14.2	0	1	0	74.4	5.6	0	0	58.8	0.7	0
High	0	0	0	0	0	0	0	0	0	7.4	0	0	83.4	0.1	45.5	8.3
Relative Importance	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Low	Low	Low	High	Low	Low	High	Moderate	High	Moderate

Potential Resource Conflicts: Entanglement in high seas flying squid driftnet fisheries has been a significant cause of mortality in the North Pacific. A survey of BC salmon fishermen determined that Pacific white-sided dolphins do become entangled and die in nets, however the proportion of entangled small cetaceans (an estimated 43 to 59 killed annually in salmon fishery) that are actually Pacific white-sided dolphins was not determined (Stacey *et al.* 1990).

32.3.4.5 Dall's Porpoise

Population Size and Trends: There are no estimates for the size of the Dall's porpoise population in the eastern North Pacific, although it is estimated that 1.4 to 2.8 million occur throughout the entire North Pacific and Bering Sea (Jones *et al.* 1987 cited in Jefferson 1990). A recent survey of the outer coast of Washington and Oregon estimated a population of 1,550 to 2,950 there (Green *et al.* 1992). Calambokidis *et al.* (1997b) estimated a population of 1,545 Dall's porpoise in the Strait of Juan de Fuca and the San Juan and Gulf Islands. The highest numbers of sightings were among the Gulf Islands. There are no estimates for any other areas of the BC coast.

Distribution: Dall's porpoises appear to be year-round residents, at least in certain areas of the coast. They generally occur in small groups of 1 to fewer than 10 individuals and there is some seasonal movement, probably related to seasonal prey availability (Miller 1988). Dall's porpoises feed on squid and small schooling fish (Jefferson 1990) and based on studies in the Strait of Juan de Fuca seem to prefer waters ≥ 50m (Howes *et al.* 1993). They have been sighted in Milbank Sound and Finlayson and Mathieson channels (Planning Units 3 and 4), Goletas Channel and Queen Charlotte Strait (Planning Unit 13) and Johnstone Strait (Planning Unit 15) (Jefferson 1990). Using this limited information, parts of the planning area were identified as either areas of known Dall's porpoise distribution based upon limited sightings and the opinion of experts (G. Ellis, DFO, J. Ford, pers. comm.), or as areas of probable distribution based on the water depth and abundance in adjacent areas (Table 32).

Table 32. Percentage of area within Marine Planning Units with low, moderate and high relative abundance of Dall's porpoise and relative importance of each planning unit to the species.

Relative Abundance	*32.3.4.5.1.1 Marine Planning Unit*															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Low	0	0	0	0	0	0	51.3	0	13.9	0	47.4	55.8	0.1	0	45.5	88.4
Moderate	81.5	65.4	3.1	62	20.5	36.5	12.5	76.9	49.5	82.8	4.3	0	3.9	55.3	0.6	0
High	0.6	1.4	64.6	29.5	28	6.9	0	0	0	2	0	0	69.6	0	17	0
Relative Importance	Moderate	Moderate	High	High	High	Moderate	Low	Moderate	Moderate	Moderate	Low	Low	High	Moderate	High	Low

Potential Resource Conflicts: A survey of BC fishermen determined that Dall's porpoises do become entangled and die in nets, however the proportion of entangled small cetaceans (an estimated 43 to 59 annually in the salmon net fisheries) that are actually Dall's porpoise was not determined (Stacey *et al.* 1990).

32.3.4.6 Harbour Porpoise

Population Size and Trends: Results of a recent aerial census of the Strait of Juan de Fuca, the Gulf Islands, San Juan Islands and Strait of Georgia suggests about 6,400 animals inhabit this area (Calambokidis *et al.* 1997b). Aerial surveys of the outer coast of Washington and Oregon have resulted in estimates of 3,461-6,655 (Green *et al.* 1992). There are no such estimates available for the BC outer coast, although Gaskin (1992) suggests BC waters might sustain a population of some 15,000 to 20,000 animals. The harbour porpoise is included on the provincial blue list.

Distribution: Harbour porpoises occur year-round in the BC waters, usually in small groups of a few animals but there are reports of unusual aggregations of more than 20 individuals (Ford pers. comm. 1996). It is likely that seasonal changes in porpoise distribution occur on the BC coast that are tied to the movements and availability of prey (Gaskin 1992). Harbour porpoises feed on small schooling fish, Pacific herring, mackerel and hake. In general, harbour porpoises seem to prefer areas that have pronounced coastal fronts or topographically induced upwelling (Gaskin 1992). Off the west coast of Washington and Oregon, Green *et al.* (1992) found almost all porpoises in waters <100m deep but harbour porpoises are rarely found at depths less than 7 to 10 m unless the bottom is sandy and the current weak (Gaskin 1992). It seems that for the most part, where they are found in water deeper than 100m, the distance to shore is small as occurs in channels and passages, for example, among the San Juan Islands (Calambokidis *et al.* 1993). The following depth and distance from shore ranges were compiled from recent survey results from the Strait of Juan de Fuca, Washington coast, and Puget Sound (Calambokidis *et al.* 1992), and were used to construct a model to map probable harbour porpoise distribution. The majority of sightings:

- occurred within 11 km of shore
- were most common between depths of 10 and 125 m
- were less common between depths of 125 m and 180 m
- were unlikely in depths of less than 7 m
- were unlikely in depths of more than 180 m unless the shore was less than 11 km away.

Based on this model, a large percentage of all of the planning units is expected to be of importance to harbour porpoises (Table 33), especially those units with large areas of shallow coastal water (Planning Units 13, 14 and 16).

Table 33. Percentage of area within Marine Planning Units with low, moderate and high relative abundance of harbour porpoise and relative importance of each Planning Unit to the species.

Relative Abundance	*32.3.4.6.1.1 Marine Planning Unit*															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Low	0	0	0	0	0	0	0	0	0	8.2	0	0	0	0	0	0
Moderate	58.5	42	57.8	73.1	31.7	36.7	63.6	70	60.5	40.3	47.1	68.5	1.5	7.1	30.2	0
High	17.5	49.9	36.7	26.8	67.8	62.8	35.4	28.7	37.8	37.7	49.6	20	90.1	76.1	56.4	93.3
Relative Importance	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High

Potential Resource Conflicts: Harbour porpoises are known to have declined in numbers in some parts of their range (e.g. Puget Sound, Washington). Chemical contaminants, entanglement in fishing gear and sensitivity to heavy vessel traffic are believed to be factors (Calambokidis and Baird 1994). Scheffer *et al.* (1948) presented several anecdotal accounts of harbour porpoise becoming entangled in salmon traps and gill nets in Puget Sound and among the San Juan Islands and suggest that it was probably a significant source of mortality at the time. Entanglement in gill nets is recognised as a serious impact in other areas, particularly along the coast of Labrador, Newfoundland, in the St. Lawrence and in the Bay of Fundy where efforts have been made to assess the level of incidental catch (see review in Gaskin 1992). A survey of BC fishermen in 1989 confirmed that incidental catches of harbour porpoise, Dall's porpoise and Pacific white-sided dolphins do occur, particularly in gill nets and seine nets in the salmon fishery. An estimated 43 to 59 animals are believed to die annually, although, this number may be higher. The proportion of these animals that are actually harbour porpoises was not determined (Stacey *et al.* 1990). Efforts to quantify this should be made.

Acoustic deterrent devices (ADDs) used at salmon farms as a non-lethal method to deter pinnipeds appear to have significant impacts on harbour porpoises. A field study to document the behavioural response of harbour porpoises to the signal from an ADD showed unequivocally, that harbour porpoise sightings within a 3.5km zone around the site of the ADD installation declined precipitously when the ADD was activated. The response was elicited consistently during 3 six-week sampling blocks during which the ADD was activated for 3 weeks and then deactivated for three weeks. The results were highly significant and could not be attributed to any other variables (Olesiuk *et al.* 1996). Harbour porpoises appear to be highly sensitive to this form of disturbance and the impact of these sounds appears to be appreciable habitat loss and/or impedance of normal travel patterns. The magnitude of impacts on the population are not known.

32.3.4.7 Uncommon cetacean species

The following species are not common on the coast or do not occur in large numbers. With the exception of the minke whale, all were hunted commercially by BC coastal whalers between 1905 and 1967. Virtually all that is known of these species in BC comes from the historical catch record augmented by a few present-day sightings. It seems evident that the infrequency with which these species are now reported is more the result of historical exploitation than merely low observer effort.

32.3.4.7.1 Blue whales

Blue whales were probably never very abundant in BC waters. Between 1905 and 1967, 1,364 blue whales were caught here, a comparatively small number compared to the number of fin whales or even humpback whales caught during the same period. In fact , it is estimated that the pre-exploitation population of these whales in the North Pacific was only about 5,000 animals and current estimates indicate only 1500 remain (Leatherwood *et al.* 1983). Recent aerial surveys of the coast of Washington and Oregon did not find any blue whales (Green *et al.* 1992) and there are only three recent sightings of blue whales documented in BC waters (J. Ford unpubl. data; K. Morgan unpubl. data). Based on the distribution of historical catch in BC, it would seem that blue whales preferred the deeper waters offshore of Vancouver Island and the west coast of the Queen Charlottes. Although some were caught in Dixon Entrance, they rarely ventured into Hecate Strait.

32.3.4.7.2 Minke whales

Minke whales are sighted with regularity in near shore areas of BC and should be expected in the study area, but they are not abundant. Typically single animals are encountered. They feed on small schooling fish including herring and sandlance as well as on copepods and euphausiids (Leatherwood *et al.* 1982). There are no reliable population estimates for this species in the Eastern North Pacific (Stewart and Leatherwood 1985 cited in Green *et al.* 1992). In large part this is due to their low profile and indistinct blow, which makes it easy to miss them at sea. Like other rorquals, minke whales migrate to warmer latitudes in winter and move north in spring and summer. A total of 30 individuals has been identified over a ten-year period in the waters around the San Juan Islands (Calambokidis and Baird 1994). Virtually all recent sightings of minke whales in BC waters are from coastal protected waters (J. Ford unpubl. data; K. Morgan unpubl. data) including Queen Charlotte Strait, Blackfish Sound, the Broughton Archipelago, Fitz Hugh Sound and Burke Channel. They are no doubt visitors throughout the planning area.

32.3.4.7.3 Fin whales

The current population estimates for the entire North Pacific is about 16,000 (Leatherwood *et al.* 1982). Historically, 7,516 were killed in BC by commercial whalers between 1905 and 1967. Judging from the large numbers of fin whales caught, they were very abundant, perhaps even summer residents in BC waters (Pike and MacAskie 1969). Fin whales were caught along the west coast of Vancouver Island and the Queen Charlotte Islands, in Dixon Entrance and even in Hecate Strait. In fact, many fin whales were caught along the mainland side of Hecate Strait, in Queens Sound, Milbanke Sound and Caamano Sound. Fin whales were caught throughout the whaling season, but the biggest catches occurred in July and August. Like the other large whales, fin whales migrate north to feed in summer and southward to breed in winter (Mizroch *et al.* 1984). A few recent incidental sightings of fin whales indicate that they some occur in BC (J. Ford unpubl. data), but only 27 were seen during recent aerial surveys of the outer coast of Washington and Oregon (Green *et al.* 1992).

32.3.4.7.4 Sei whales

Sei whales were largely ignored by early BC whalers because of their small size and high swimming speed. They were not of interest until the 1950's when a new market in Japan for fresh whale meat was developed. Consequently, the majority of the 3,762 sei whales caught in BC waters were actually caught after 1952. They seem to have been numerous offshore and, like blue whales, were caught mainly off the west coast of Vancouver Island and the Queen Charlotte Islands. The pre-exploitation population in the North Pacific is believed to have been 63,000 animals. Today, that population has been reduced to 14,000. Green *et al.* (1992) did not see sei whales during aerial surveys of the Washington and Oregon coast and only 11 recent sightings are reported from BC waters (J. Ford unpubl. data; K. Morgan unpubl. data).

32.3.4.7.5 Sperm whales

Sperm whales occur in pelagic waters throughout the North Pacific, wintering in lower latitudes and move northward in spring and summer to feed. The current population is estimated to be 274,000 in the eastern North Pacific, 12% below pre-exploitation levels. Over 6,000 sperm whales were caught off the west coast of Vancouver Island and the Queen Charlottes between 1905 and 1967. The vast majority of the catch was taken in waters >1000m deep off Vancouver Island and the Queen Charlotte Islands, but some were caught in Hecate Strait and a few were even taken in Milbanke and Caamano Sounds. Only 36 sperm whales were observed during recent aerial surveys of Washington and Oregon (Green *et al.* 1992). A small number of incidental sightings from the west coast of Vancouver Island and the Queen Charlottes indicates that this species still occurs in BC waters though few in number (J. Ford unpubl. data; K. Morgan unpubl. data).

32.3.4.7.6 Northern Right whale

The northern right whale was commercially extinct in the North Pacific by the beginning of the 20th century and it is thought that there are probably no more than 200 to 240 right whales left in the entire North Pacific (Leatherwood *et al.* 1983). The International Convention for the Regulation of Whaling was drawn up in 1935 and gave protection to the right whale. Sadly, prior to 1935, eight right whales were caught off the Queen Charlotte Islands by BC whalers. All were caught early in the whaling season in May and June. In 1951, a ninth right whale was accidentally taken in July off the west coast of Vancouver Island. Today sightings of right whales remain extremely rare.

33. 8.0 Potential Resource Conflicts in the Central Coast Region

The human population in the Central Coast planning area is sparsely distributed and numbers about 4400. The majority of the residents live in the Bella Coola Valley. There are no large communities in the southern planning area. The CCLCRMP Preliminary Socio-Economic Base Case (Enemark Part 1 this report) outlines the major economic activities and population structure in the region. The main existing or potential human use activities that potentially affect the marine and coastal environments of the Central Coast planning area are summarised in Table 34 below. The source of all data on human activities is databases compiled and maintained by the Land Use Co-ordination Office (LUCO).

Table 34. Categories of human use of marine resources in the Central Coast planning area.

Activity	Description of Database Layer
Settlements	
Population centres	Population size and location
Logging camps	Location (data currently incomplete)
Aquaculture	
Existing	Finfish, Shellfish tenures
Capability	Salmon net cage aquaculture and shellfish beach and off-bottom culture
Industrial	
Log handling	Storage and sorting areas (dumps and booms), helicopter drop zones
Mining	Nearshore subtidal and backshore mineral or gravel extraction
Beachcombing	Professional log salvage
Recreation	
Anchorages	Rated as to importance (quality)
Marinas, Lodges, etc	Rated as to size and services
Campsites	Number of sites and facilities
Docks	Mooring buoys, Docks, Floats, piers, boast launches, etc
Kayaking	Routes and staging areas
Scuba	Dive sites
Wildlife viewing	Sites rated as to use, accessibility, uniqueness
Transportation	
Routes	Shipping lanes, traffic volumes (other than ferries)
Ferries	Docks, traffic volumes
Commercial, Native and Recreational Fishing	
Net	Gillnet/Seine for Salmon, Herring roe/bait
Trap	Crabs, prawns, sablefish
Impoundment	Herring spawn-on-kelp, herring bait holding
Trawl	Groundfish, shrimp
Intertidal	Clams, Oysters
Hook & Line	Salmon, groundfish (troll, handline, longline)
Dive	Geoduck, sea cucumber, sea urchin, octopus

The current knowledge of most of the resource and human use layers is too crude to identify specific locations where resource conflicts may occur. Regions where the marine resources are most important or abundant have been outlined in this base case. Table 34 lists the human use activities that have been mapped by LUCO for the region. The following Table 35 specifies (with "X's" in the appropriate cells) which activities and environmental values are most likely to be characterized by potential conflicts. CCLCRMP participants can then use this information to assist them in prioritizing conflict areas and designing appropriate resource management objectives to deal with the conflicts.

Table 35. Potential impacts matrix for marine resources vs. human use in the Central Coast LCRMP base case analysis.

		Settlements	Aquaculture	Forestry	Mining	Recreation	Oil transport/drilling	Vessel Traffic	Commercial, Native & Recreational Fishing						
									Net	Trap	Impoundment	Trawl	Intertidal	Hook & Line	Dive
Kelp Beds		X		X	X		X				X	X			
Estuaries		X	X	X	X		X								
Reefs					X							X			
Invertebrates		X	X	X	X	X	X			X		X	X	X	X
Pelagic fish				X			X		X		X				
Groundfish		X	X		X		X			X		X		X	
Marine Birds	**Marbled Murrelets**		X			X	X		X		X				
	Colonial Alcids		X			X	X		X		X				
	Procellariiformes						X								
	Laridae						X		X						
	Shorebirds	X	X	X			X				X				
	Cormorants	X					X				X	X			
	Waterfowl/Divers	X	X	X		X	X				X				

Marine Mammals	**Sea Otters**		X			X	X								
	Seals		X				X		X					X	
	Sea lions		X				X		X					X	
	Killer whales					X			X						
	Humpback whales		X						X	X	X				
	Gray whales		X			X	X		X	X	X				
	Pacific white-sided Dolphins		X						X						
	Dall's porpoise		X						X						
	Harbour porpoise		X						X						
	Fin Whale					X		X							
	Sperm Whale									X				X	

34. 9.0 REFERENCES

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Central Coast
Land and Coastal Resource Management Plan

Base Case

Part 4

Environmental – Anadromous/Freshwater Fisheries

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Anadromous/Freshwater Fisheries Account - Base Case Trends	
Salmon spawning and rearing habitat	• All 5 salmon species produced in the plan area. • Total of 537 known salmon producing systems (North: 384, South: 153). • 9 chinook stocks, 60 coho, 18 sockeye, 35 pink and 40 chum stocks identified as having a high risk of extinction within the plan area. • Total of 6276 kilometers of known fish habitat, with 3237 in the north forum and 3039 km in the south forum. • 21% of the fish streams in the north forum are within the THLB whereas a slightly higher proportion (29%) of fish streams in the south forum are within the THLB. These areas are most likely to be developed according to the minimum guidelines of the FPC. • 178 fisheries sensitive watersheds identified by DFO/MELP analysis. • Sensitive fisheries watersheds will require higher than minimum standards outlined by the FPC. • Compliance monitoring and enforcement for resource development activities needs to be regularly conducted. • Species outlook for 1998 – 2001 for sockeye and coho are below average whereas chum and chinook are expected to be average. • Rivers Inlet and Smith Inlet sockeye stocks are drastically declining and will yield poor escapement through 2002. • Even year pink stocks in Central Coast are increasing after several cycles of low abundance
Trout/Char spawning and rearing habitat	• Steelhead trout, rainbow trout, cutthroat trout, Dolly Varden char and brown trout are produced in the plan area; distribution is throughout the plan area. • Key steelhead systems include: Dean River, Wakeman River, Kingcome River, Bella Coola River, Glendale, Ahnuhati, Kakweiken, Atwaykellesse and Wahpeeto Rivers. • Existing habitat protection guidelines are inadequate in protecting fish and fish habitat values. There is a need to improve riparian protection by increasing the % retention from the minimum values outlined by the FPC guidelines, particularly for S4 (<1.5 meter fish bearing) streams.
Eulachon spawning habitat	• 9 primary eulachon producing system in the plan area: Dean River, Kimsquit River, Taleomey River, Asseek River, Bella Coola River, Kingcome River, Wannock River, Chuckwalla/Kilbella Rivers, and Klinaklini/Franklin Rivers. • Culturally important species and a highly regarded food fish by First Nations people. • Eulachon plays an important role in the food chain. • Many stocks are declining in abundance, and the cause is uncertain, but is likely associated with spawning habitat degradation and large scale oceanic changes. A significant amount of eulachon are intercepted as a by catch in the shrimp trawl fishery.

1.0 INTRODUCTION

The purpose of this section is to provide a description of current freshwater fish and fish habitat values and expected future trends that are expected to occur in the absence of a Central Coast Land and Coastal Resource Management Plan. Within the context of this chapter, "freshwater fish and fish habitat values" includes freshwater and anadromous salmonids, and the habitat they depend on for spawning, incubation, rearing and migration.

The chapter is organized into 6 main sections with the first section detailing important habitat requirements for salmonids, the potential impacts of resource development on fish habitat and existing habitat protection policies. The focus of the second section is freshwater fish habitat in the CCLCRMP, and includes background information, as well as the current status of fish habitat in the plan area, and a discussion of future trends in fish habitat management. The third section is a description of salmon escapement, catch and total stock trends, while the fourth section consists of information on the abundance and distribution of trout and char species. Section 5 is a discussion of background as well as the current status and future trends for eulachon. Section 6 is a summary of the current status of resource development activities that can potentially impact freshwater fish habitat values.

34.2 Scope and Limitations

The terms of reference for this section are to describe the current environmental situation and forecast expected future trends for freshwater fish and fish habitat in the CCLCRMP study area. More specifically, the purpose of the following chapter is to:

- Devote primary attention to those values that are most expected to be affected by resource development activities on Crown land or in the marine/aquatic environment
- Describe important habitat requirements of salmon, trout and eulachon
- Describe the trends in abundance of exploited salmonid species
- Examine the implication of current land and marine management regimes on the productive capacity of freshwater fish habitat;
- Overlay CCLCRMP Base Case land use zones with the sensitive watersheds that have been mapped by DFO to determine whether current management guidelines are sufficient to sustain fisheries values.
- Consult with stakeholders, including aboriginal groups
- Report commercial catch data for key salmon stocks by DFO Statistical Areas.

The information in this report has been collected from CCLCRMP stakeholder groups, non-government organizations, industry, federal government and provincial government representatives. The information was obtained through a review of existing CCLCRMP documents in addition to references provided by government agencies. Phone interviews were conducted to incorporate recent unpublished information. Unfortunately, time and budget constraints did not allow travel time and expenses to conduct personal interviews or review streamfiles located in district fisheries offices.

34.3 Background

The CCLCRMP Plan Area supports 5 species of anadromous Pacific salmon; sockeye (*Oncorhynchus nerka*), chinook (*O. tsawhytscha*), coho (*O. kisutch*), chum *(O. keta)* and pink (*O. gorbuscha*); anadromous cutthroat trout (*Salmo clarki*), steelhead (*O. gairdneri*) and Dolly Varden char (*Salvelinus malma*). As well, resident populations of cutthroat, rainbow and brown trout (*Salmo trutta*) which is an introduced species, Dolly Varden and kokanee (*O. nerka*) are produced within the study area (Reid 1984).

34.3.1 Key Habitat Requirements of B.C. Salmonids

Freshwater fish habitat includes all aquatic features (lakes, streams, rivers, wetlands and estuaries) plus riparian lands adjacent to them. The quality of instream fish habitat is dependent on the presence of a functioning riparian zone as stream vegetation provides food, temperature control, bank stability, large organic debris and buffers against non-point source pollution (DFO 1998a). The quality of freshwater fish habitat is also dependent on the hydrological and geomorphological health of the watershed. Changes to the natural hydrological regime or natural geomorphological processes can significantly affect stream productivity by altering the quality and quantity of available fish habitat within a stream. Therefore, key habitat for fish includes all freshwater waterways from headwater tributaries to mainstem river systems within the Plan Area.

Within the aquatic environment, the four basic requirements for fish survival are adequate water conditions, food, cover and access. Habitat requirements vary throughout the various freshwater life history stages that includes adult migration and spawning, incubation of eggs, hatching/emergence of fry, juvenile and adult rearing and juvenile outmigration to the ocean. The most sensitive stage for salmon survival is during spawning and incubation where clean gravels of different particle sizes and relatively clean, well-oxygenated water are required (Toews and Brownlee 1981). Habitat requirements also vary between species. For example, chinook spawners prefer deeper (>24 cm), faster (30 cm/s) water with larger substrate size (1.3-10.2 cm) than cutthroat trout (depth >6 cm, velocity 11-72 cm/s and substrate size 0.6-10.2 cm) (Bjornn and Reiser 1991). During the rearing phase, stable stream conditions with adequate maintenance flows, temperature, cover and food are required by all salmonid species. Acceptable levels for stream conditions including water temperature, turbidity, dissolved oxygen, pH and total dissolved solids have been established on a regional basis.

Stream productivity is based on a combination of internal and external nutrient energy pathways. The quality of instream salmonid habitat can be significantly influenced by the presence of natural streamside vegetation. For example, the riparian zone of small forested streams is a major source of nutrients, which enter the streams as fallen needles, leaves and insects. Algal production is often light-limited in these smaller systems and only makes a small contribution to the overall energy budget (Toews and Brownlee 1981). Larger streams depend on an internal "instream" pathway where primary production of algae through photosynthesis is the most dominant pathway for nutrient production. In general, large streams are more influenced by cumulative upstream events than smaller headwater systems. The carcasses of anadromous salmon are an important source of nitrogen and phosphorous. (PFRCC 1999).

34.3.2 Potential Impacts of Resource Development Activities to Fish Habitat

The sustenance of the fisheries resource is dependent on the protection of important freshwater habitat conditions and unrestricted access into the habitats during the appropriate season, are maintained. The major resource development activity in the CCLCRMP is forestry, with much smaller amounts of mining, agriculture and urban development. Impacts to freshwater impacts can be at the watershed level, including changes to peak flows, drainage patterns, channel morphology and/or sediment loads or site specific impacts including road encroachments, slope/road failures into the stream channel or riparian degradation. In the marine environment, important rearing habitat for salmonid juveniles can be affected by commercial fishing and industrial development of nearshore areas. Some of the most common impacts of resource development on freshwater fisheries values include:

- Alteration of the natural hydrologic regime may occur when a significant proportion of the watershed area has been logged. A study from Oregon indicates that when the combination of clearcutting and roads encompass >25% of the watershed area, there *may* be an increase in peak flows (Jones and Grant, 1996). Removal of the forest canopy reduces evapotranspiration[78] rates, increasing water delivery rates to streams and ultimately increases peak flows. Road construction also increases soil compaction that in turn reduces the absorption of water and increases surface runoff to streams.
- Roads have the potential to increase natural rates of sedimentation into the stream channel by increasing landslide activity and surface erosion. Increased sediment loads can reduce the quality of spawning habitat and reduce survival of incubating salmonid and eulachon eggs.

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[78] Evapotranspiration is the loss of water from the soil both by evaporation and by transpiration from the plants growing thereon.

- Forestry, mining, agriculture and urban development can result in degradation of riparian areas. Destruction of riparian habitat can decrease channel and bank stability, reduce the capability of riparian areas to filter sediment from surface erosion and decrease cover, shade, the frequency and supply of large woody debris, litterfall and food production in streamside areas.
- Logging and/or road construction on steep or unstable terrain (high terrain hazard areas) can increase the natural frequency of slope failures and result in increased sediment delivery to stream channels.
- The diversity of salmonid species can be reduced when greater than 25% of the basin has been harvested (Reeves *et al.* 1993).
- Nearshore marine habitat can be degraded or made inaccessible to rearing salmonids due to log dumping, booming and log sort areas.

In addition to the impacts of terrestrial resource development activities on salmonid species, there is a risk for aquaculture operations to negatively affect native salmon and trout species in the following ways:

- *Interbreeding by escaped farm salmon:* There is a potential risk of genetic damage to wild stocks ***if*** large numbers of Pacific salmon escape and ***if*** successful interbreeding with wild non-specific stocks occurs over a number of years (SAR 1997). However, at this time, there is only a low risk of Atlantic-Pacific salmon hybridization. For more detailed information see the Environmental Assessment Office Salmon Aquaculture Review (SAR), Volume 3 by Alverson and Ruggerone.
- *Colonization of escaped Atlantic salmon:* To date, juvenile Atlantic salmon have been found in three streams and two lakes within B.C. All juveniles were of hatchery origin with the exception of juveniles captured in the Tsitika River, located on the north-east coast of Vancouver Island. Two age classes of juveniles were produced through successful, wild spawning of escaped Atlantic salmon adults for two consecutive years in the Tsitika River (Rimmer 1998). As of 1998, the relative abundance of Atlantic salmon in the Tsitika River was low in comparison to steelhead and coho salmon. Atlantic juveniles complete for the same food and habitat as steelhead juveniles and the depressed status of native steelhead stocks on Vancouver Island is providing the opportunity for Atlantic salmon to colonize coastal streams (Rimmer 1998).
- *Fish Health:* There is potential for farmed fish to expose native stocks to exotic diseases, and increase the risk of disease transfer to native species (SAR 1997). Currently, there is no evidence of exotic pathogens or parasites having been introduced to BC and the Technical Advisory Team found the probability of exotic disease outbreaks to be low (Truscott, pers. comm). Infectious Salmon Anemia (ISA) has never been diagnosed in any wild or farmed salmon in BC. BC currently has strict importation policies allowing importation of eggs only from approved cultured salmon stocks. Stringent quarantine and disease testing procedures follow importation. Given the current knowledge of ISA, the risk of this disease occurring in BC salmon, wild or cultured, is low (Truscott, pers. comm).
- *Release of wastes into the aquatic environment:* Waste products including fish food, fish excretory products, organic matter from net-cleaning, medicines and other chemicals used on fish farms are released into the aquatic environment. There is potential for humans to ingest those drugs through the consumption of seafood (SAR 1997). Copper from net anti-foulant agents, and antimicrobials are also released into the environment with some antibiotics persisting in sediments for up to 500 days after continued use. The transfer of chemicals from sediments to biota is not well understood at this time (SAR 1997).

Provincial and Federal fisheries biologists are monitoring the status of Atlantic salmon colonization in the wild as well as researching the effects and risks associated with salmon aquaculture on wild stocks in the marine environment. At the present time, the Salmon Aquaculture Review concludes that salmon aquaculture, as currently practiced and at current levels of production, presents a low overall risk to wild fish production and the marine environment (SAR 1997).

The productivity of anadromous salmonids is also affected by marine resource development activities including commercial fishing and industrial shoreline development as well as large-scale oceanic factors. Therefore, the protection of estuarine and nearshore juvenile rearing and salmonid feeding habitat is critical for sustaining anadromous stocks. Please refer to the marine portion of the Base Case for more details.

34.3.3 Habitat Protection for Freshwater Fish Habitat

Within B.C., management responsibilities for fish habitat are divided between the federal and provincial government. Under the Canadian Constitution, DFO manages salmon populations and salmon habitat, while the province manages freshwater fish including steelhead and fish habitat. The provincial government also manages and allocates land and water. In some cases, provincial authority is delegated to municipal and regional governments, particularly in settlement areas. Approval authority for alterations to land and water rest with provincial ministries (Ministry of Forests (MOF), Ministry of Transportation and Highways (MOTH), Ministry of Energy, Mines and Mineral Resources (MEM), BC Assets and Land Division (BCALC), Ministry of Environment, Lands and Parks (MELP)) or local government organizations. DFO does not permit, approve or manage land or water resources but continues to actively review development proposals (DFO 1998a).

The federal and provincial governments operate under independent habitat management objectives and policies. DFO's long-term habitat management policy strives to achieve an overall net gain in the productive capacity of fish habitat by achieving no net loss in the productive capacity of fish habitat from resource development activities (DFO 1986). The three supporting goals of this policy are to conserve fish habitat, restore fish habitat and to develop fish habitat. MELP's mission statement for habitat management is to sustain the diversity and integrity of BC's ecosystems through habitat protection (MELP 1996a). The goals of the Habitat Protection Program are (MELP 1996a):

- to maintain the diversity of habitats and ecosystems;
- maintain threatened and endangered habitat, or rare and endangered species;
- advocate resource management alternatives that favor ecological integrity;
- support, enhance and share an ecological knowledge base and
- to promote the understanding of ecological principles through communication and education.

Both federal and provincial governments utilize the Federal Fisheries Act. The Federal Fisheries Act is strong environmental legislation but only applies after there has been a harmful alteration of habitat or the deposit of a deleterious substance. As the provincial government manages, controls and plans land and water use, it has the ability to legislate proactive planning and preventative measures (DFO 1998a). Improved protection requires increased conservation ethic, provincial land and water use legislation that emphasizes conservation; policies/regulations at all levels of government which are consistent with fish habitat protection; improved stewardship by private landowners and improved financial incentives to landowners (DFO 1998a).

Other legislation to assist in sustaining viable fish habitat includes the Fish Protection Act that was legislated in 1997 (MELP 1997). The objectives of the Fish Protection Act are to ensure water for fish, to protect and restore fish habitat, to protect and enhance riparian habitat and to strengthen local environmental planning. This new legislation will provide better protection of water flows for fish, and provide improved riparian protection on private and public lands. The Fish Protection Act requires stronger management measures for sensitive streams and/or fish stocks and strengthens the power of local government to protect fish habitat. Other initiatives that can improve protection and/or restoration of fish and fish habitat includes: Fisheries Renewal BC; the Forest Practices Code; the Protected Areas Strategy; the Watershed Restoration Program and the Urban Salmon Habitat Program.

35. Freshwater Fish Habitat

There are a total of 537 (North: 384, South: 153) known salmon-producing systems within the CCLCRMP area (DFO 1998c) (Fig 1). In addition to salmon producing systems, there are several small, undocumented anadromous and resident fish streams within the plan area.

During the spring of 2000, the Department of Fisheries and Oceans and MELP completed a sensitive watershed analysis for the CCLCRMP plan area. A total of 178 high value fisheries watersheds were identified as being sensitive to future resource development with 106 watersheds/sub-basins located in the north forum and 72 drainages in the south forum (DFO 2000a).

The purpose of this section is to provide a current status of freshwater fish habitat within the CCLCRMP plan area and include summarized results from the habitat based analysis completed by DFO and MELP. This chapter also includes interview information regarding the future trends of fish habitat management in the absence of the CCLCRMP process.

The sensitivity of each high value fisheries watershed was categorized into 4 different types according to the current state of development, natural terrain instability ratings, First Nations values and known fisheries values (Table 1). Other factors used to identify sensitive watersheds included hydrologic sensitivity, as well as ongoing stock enhancement or stock management activities. Type "A" watersheds have extensive past forestry development or other forms of human disturbance whereas Type "B" watersheds are undeveloped with sensitive fish habitat features and/ natural terrain instability. Type "A/B" watersheds are logged in the lower river area, while the upper watershed area is relatively intact. The fourth type is "B/ND" describes watersheds with limited resource development and DFO is proposing no further development in order to maintain high fisheries values, and be utilized as "reference watersheds".

Table 36. Description of DFO's sensitive watershed classifications used in the analysis to identify sensitive fish streams within the CCLCRMP study area.

Sensitive Watershed Type	Description	North Area	South Area	Total
A	Watersheds with extensive past forestry development or other forms of human disturbance.	6	60	66
B	Unlogged watershed with sensitive habitat features and/or watershed with natural terrain stability issues	35	9	43
A/B	Combinations of the above two categories. In many cases, the lower watershed has been developed, while the upper watershed is intact, with high terrain stability issues.	62	2	65
B/ND	Limited resource development to date and no further development is proposed by DFO in order to maintain high fisheries values, and be utilized as reference watersheds (Koeye River, and 4 sub-basins to Owikeno Lake: Dallery River, Ashlum River, Kwap (Amback) River and Genesee River)	5	0	5
	Total number of sensitive fisheries streams	**108**	**72**	**178**

Figure 1. Known distribution of salmonids in the North and South Forums of the Central Coast LCRMP

35.1

35.2 Background

All five Pacific salmon species, as well as steelhead/rainbow trout, cutthroat trout, Dolly Varden char/bull trout, kokanee, eulachon, and several other resident fish species are produced in streams within the Plan Area. Important steelhead producing systems within the CCLCRMP area include the Dean River, Wakeman River, Kingcome River, Bella Coola River, Glendale, Ahnuhati, Kakweiken, Atwaykellesse and Wahpeeto River systems (Axford 1998; Leggett, pers. comm). Fish producing systems within the plan area range from larger river systems including the Klinaklini River and the Kilbella River both having over 100 kilometers of fish habitat, to small tributary systems with less than 1 kilometer of known fish habitat.

Within the CCLCRMP study area, there are a total of 3,237 kilometers of ***known*** fish habitat in the North Forum (Fig 1)(CCLCRMP 1999). It is important to note that "known" fish-producing streams does not include numerous undocumented small and/or isolated systems supporting small runs of coho, chum and pink salmon, as well as resident trout and char. Out of the total of 3,237 kilometres of "known" fish habitat, a large portion is located in non-forested exclusions (57%) and forested exclusions (22%), leaving only 21% (671 kilometers) of fish streams within the timber harvesting landbase (THLB) (CCLCRMP 1999).

There are a total of 3,039 kilometres (0.2% of the gross landbase) of known fish habitat in the ***southern*** portion of the CCLCRMP study area. Approximately 871 kilometres (29%) of known fish habitat are located within the timber harvesting landbase whereas 1362 (45%) kilometres are located in non-forested exclusions and an additional 806 (26%) kilometres located in forested exclusions.

35.3 Current Status

According to the DFO/MELP analysis, forestry development has been higher in the south forum where 60 out of 66 (91%) Type A (developed) watersheds are located (Table 1) (Fig 2). There are very few undeveloped Type B (9 streams) or A/B (2 streams) fisheries sensitive watersheds identified for the southern portion of the plan area. There are no fisheries reference watersheds proposed in the South Forum (Table 1).

The northern portion of the plan area has fewer Type A (developed) fisheries watersheds and the majority of Type B (undeveloped) sensitive fisheries watersheds in the plan area (Fig 2). There are a total of 35 out of 43 (81%) Type B watersheds located in the north forum as well as 62 out of 64 (97%) of the Type A/B watersheds (developed lower, undeveloped upper). The 5 Type B/ND watersheds that are being proposed as "fisheries reference" areas are the Koeye River, and 4 sub-basins to Owikeno Lake: Dallery River, Ashlum River, Kwap (Amback) River and Genesee River (Fig 2).

The impacts of forestry development on fish and fish habitat can be divided into watershed levels impacts and site specific impacts. ***Watershed level impacts*** can occur when a large portion of the watershed area has been logged, resulting in changes to the natural hydrologic regime, natural rates of sediment delivery to the mainstem and channel stability. ***Site specific impacts*** can occur when a small portion of the watershed area has been harvested, resulting in localized events including slope failures, road failures, road encroachments, loss of off channel habitat and season high water refuge habitat, bank instability and damage to riparian vegetation. The following sections discuss the current status of forestry development in sensitive fisheries watersheds for the north and south plan areas.

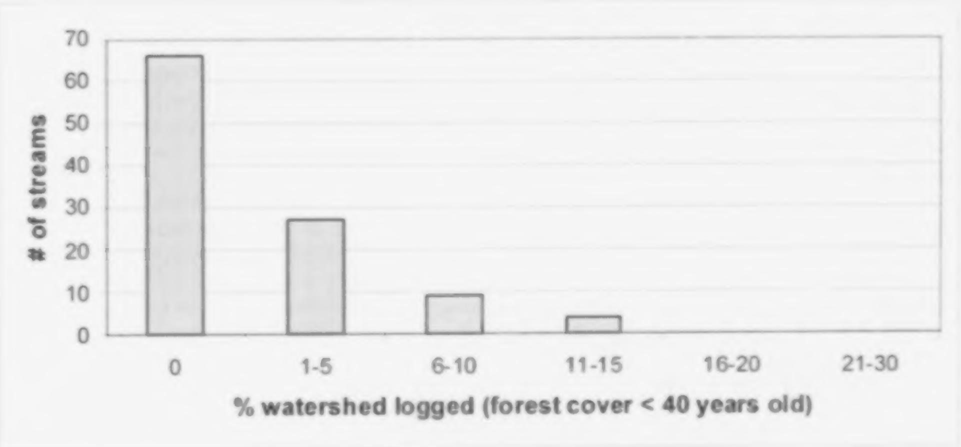
Figure 2. Location of DFO's sensitive fisheries watersheds within the CCLCRMP study area (DFO 2000a).

35.3.1 North Forum

Forestry development in the northern section of the CCLCRMP plan area is lower relative to the resource development activity in the south. To determine the current status of forestry development in sensitive fisheries watersheds, the amount of forest cover less than 40 years old (Age Class 1-2) was calculated (Mana, pers. comm). This is assuming that forest cover less than 40 years old has been previously logged and natural disturbance rates are low in the northern plan area.

The total watershed area logged ranges from 0% to 15% in the 108 fisheries sensitive watersheds identified by DFO/MELP. Out of 102 streams with less than 10% of their total watershed area logged, 66 streams (65%) have < 1% of their watershed area logged (Fig 3). The likelihood of ***watershed level*** impacts such as changes to the natural hydrologic regime, natural rates of sediment delivery to the mainstem and channel instability is low in watersheds with less than 1% disturbance in natural forest cover. The highest degree of logging was observed in a tributary to Owikeno Lake (15%), the Milton River (13%), the Bella Coola River (11%) and the Kwatna River (11%) (Fig 3).

Another important factor when evaluating the impacts of forestry development on fish and fish habitat is the rate of cut. In general, a higher rate of forest harvesting has a greater likelihood of being detrimental to both site specific and watershed level impacts on fisheries values. The recent rate of cut has been determined by calculating the proportion of forest cover within the watershed that is less than 20 years old. In the northern plan area, the rate of cut to 2000 was low relative to the southern plan area, with only 3 streams (Owikeno lake, Milton River and Kwatna River) out of 106 sensitive fisheries watersheds having 10 to 15% of their total watershed area less than 20 years old.



The forest cover data was generalized from 1:20,000 up to the 1:250,000 scale. DFO watersheds are derived from the 1:50,000 watershed atlas. The mismatch of scales may cause some degree of inaccuracy (Daniel Hirner, CCLCRMP Spatial Data Analyst, MELP).

Figure 3. Frequency distribution of the % of the total watershed area logged in sensitive fish streams with the North Forum (DFO 2000b).

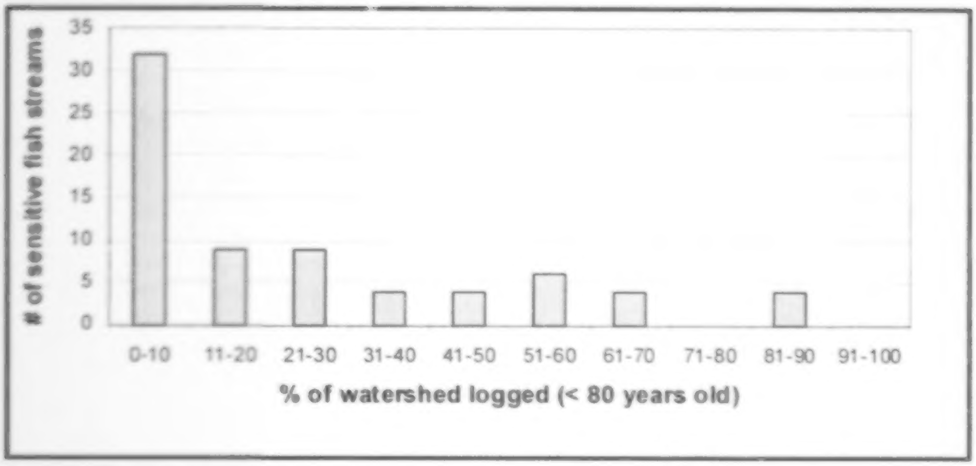
Although the total amount of logging in a given watershed may be low, forestry development can have ***site specific*** impacts on fish and fish habitat. For example, if harvesting is concentrated in valley bottom areas adjacent to sensitive low gradient fish habitat, the impacts to instream habitat and riparian habitat can be high. Other site specific impacts include slope failures, road failures, road encroachments, loss of off channel habitat and seasonal high water refuge habitat, and degradation of riparian habitat. In the above watersheds with 11 to 15% logging, there have been site specific impacts observed. DFO habitat personnel have identified an increase in natural silt loading and post harvest blowdown in the Milton River. Similarly, there has been extensive logging and linear development in the Kwatna River, with some slope failures and increased siltation observed as a result of resource development activities. In the Owikeno basin, forestry development has been concentrated in the Neechanz, Machmell and Sheemahant sub-basins. In both the Sheemahant and Machmell basins, extensive logging related impacts have occurred in the lower floodplain including isolation and destabilization of side channel and floodplain portion of tributaries from road building and logging (DFO 2000b). Streamside logging in the Owikeno basin has also increased natural rates of slope erosion, resulting into increased sediment transport to spawning and incubation habitat in floodplain reaches (DFO 2000b). Site specific impacts have also occurred in watersheds with less than 10% logging in the northern plan area (DFO 2000a).

35.3.2 South Forum

Forestry activity in the Southern Plan area was initiated earlier than in the north, and therefore the current degree of development is higher relative to the North Forum. To determine the status of forestry development in the sensitive fisheries watersheds, the proportion of the total watershed area currently less than 80 years old (Age Class 1 through 4) was calculated (Mana, pers. comm). This is assuming that forest cover less than 80 years old has been previously logged and that natural disturbance has been low in comparison to forestry development.

Watershed level impacts are linked to the total amount of logging within a drainage basin as well as the location and rate at which the timber is harvested. In general terms, the higher the proportion of the watershed area logged, the greater likelihood of altering the natural hydrologic regime, and the greater potential for negatively impacting fish and fish habitat. In the South Forum, there are 31 out of 81fisheries sensitive watersheds with 20% to 70% of their total watershed area logged (Fig 4). There are 4 watersheds (Knox Bay Creek, Robber's Nob Creek, an unnamed stream on Sonora Island and Jackson Bay Creek with a large portion (82-86%) of their watershed area logged (Fig 4). The majority (67%) of the watersheds with > 30% of their watershed area logged, were developed over 40 years ago, prior to harvesting guidelines outlined by the Coastal Fish Forestry Guidelines implemented in 1988 and the current Forest Practices Code guidelines.

Other watersheds within the southern portion of the plan area have a lower degree of development, with 32 out of 72 watersheds having 0 to 10% of the landbase harvested to date (Fig 4). Although the total amount of logging is low, if forest harvesting is concentrated along valley bottom areas adjacent to sensitive, low gradient spawning and rearing habitat, there is a high potential for site specific impacts to fish and fish habitat. For example, in Wawwatl Creek, Seymour River and a tributary to the Nekite River, approximately 6%-9% of the watershed area has been logged, indicating a low rate of development. However, 76% to 94% of the THLB is classified as Age Class 1, indicating that the majority of harvestable timber has been removed within the last 20 years. Due to the high degree of recent harvesting adjacent to valuable salmon habitat in Wawwatl Creek and the Seymour River, DFO habitat staff have priorized the protection of remaining riparian habitat (DFO 2000b).

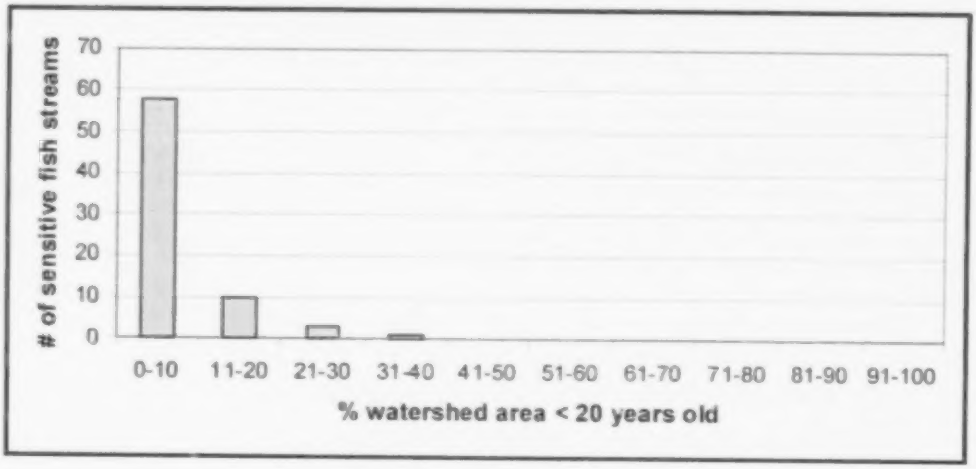


The forest cover data was generalized from 1:20,000 up to the 1:250,000 scale. DFO watersheds are derived from the 1:50,000 watershed atlas. The mismatch of scales may cause some degree of inaccuracy (Daniel Hirner, CCLCRMP Spatial Data Analyst, MELP).

Figure 4. Frequency of sensitive fisheries watersheds with forest cover less than 80 years old in the south forum (DFO 2000a).

Forest harvesting completed over a short period of time has a greater likelihood of being detrimental to fisheries values by altering the natural hydrologic regime as well as having site specific impacts on fish habitat. In order to determine the rate of recent logging activity, the proportion of Age Class 1 (< 20 years old) *within the total watershed area* was calculated for each of the sensitive fisheries watersheds in the South Forum. The analysis indicates that the majority 58 out of 72 streams have less than 10% of the total watershed area being less than 20 years old and 10 streams having 11 to 20% of their watershed classified as Age Class 1 (Fig 5). A relatively high rate of cut has occurred in Scott Cove Creek, Gilford Creek and the upper Glendale River watersheds where > 20% of the watershed area has been logged within the last two decades. An unnamed stream on Sonora Island has the highest recent rate of logging with 37% of the watershed existing as early seral stage vegetation less than 20 years old.

In order to ensure the protection of fish and fish habitat, the rate of forest harvesting should be determined according to an ecologically based unit such as a watershed or an island. The unnamed stream on Sonora Island is 95% operable, with 82% of the watershed logged to date. In addition to high degree of forest harvesting in this basin, over one-third of the logging has occurred in the last two decades, leaving 37% of the forest cover being less than 20 years old (DFO 2000a). The high rate and extensive harvesting pattern in this stream has a high likelihood of altering the natural hydrologic regime as well as reducing salmonid production in this system. In order to ensure the protection of fish habitat, both watershed level conditions as indicated by the proportion of harvesting in a watershed must be examined in conjunction with the recent rate of cut which is evident according to the proportion of early seral stage forest cover.



The forest cover data was generalized from 1:20,000 up to the 1:250,000 scale. DFO watersheds are derived from the 1:50,000 watershed atlas. The mismatch of scales may cause some degree of inaccuracy (Daniel Hirner, CCLCRMP Spatial Data Analyst, MELP).

Figure 5. Frequency of sensitive fish streams with forest cover less than 20 years old (Age Class 1) in the south forum.

35.4 Future Trends

In the current base case scenario, future management of forestry development adjacent to known fish bearing streams will be primarily directed by standard Forest Practices Code guidelines. The 1542 kilometres of known fish streams located in the THLB will be managed according to standard Forest Practices Code guidelines (Table 2). For more information regarding the constraints on timber harvesting according to the FPC and the Timber Supply Review, please refer to the Introductory Section of this document.

There are no designated areas where special management will be applied and there are no parks, protected areas or recreation areas adjacent to fish streams within the THLB. It is assumed that VQO preservation, retention and partial retention will have little effect on protection of freshwater fish habitat as VQO areas are primarily established on coastal ridges and upper slopes to protect viewscapes from the marine environment. Please refer to Part II Environmental – Terrestrial for more details on the amount and location of VQO areas.

There are a total of 89,613 hectares (2% of the study area) of land within the CCLCRMP plan area that will be managed as protected areas. The 2 largest terrestrial protected areas are Tweedsmuir Provincial Park (75,762 ha) and Fiordland Recreation Area (13,310 ha), with both parks located in the Northern Forum (Table 2). Also located in the north forum is a small protected area in the Kitlope River (55 ha). In the southern plan area, there are three small protected areas in the Atlatzi River (254 ha), the Kingcome River (146 ha) and the Thurston Bay Marine Park (84 ha) (Parksource 1999).

Although Biodiversity Emphasis areas (BEO's) have been designated within the CCLCRMP plan area, there is little difference in the protection for freshwater fish habitat between high, medium and low biodiversity options. With the application of the Land Use Planning Guide in 1999, full implementation of the biodiversity recommendations as outlined in the 1995 Biodiversity guidebook is not required and mature/old seral stage requirements are being met in constrained areas outside of the timber harvesting landbase. For more details on the ineffectiveness of BEO's in protecting fish and wildlife habitat, please refer to the "Implications of the Landscape Unit Planning Guide" in the Terrestrial Chapter of this report.

Table 37. Total Kilometers of known fish habitat by North and South Forum areas that is managed according to FPC or as a park/protected area.

Management Regime	**South Forum**	**North Forum**	**Total**
Total Km of known fish habitat	3039	3237	6276 Km
Total Km of fish streams in the THLB	871 (29%)	671 (21%)	1542 Km
Portion fish streams in the THLB managed according to standard FPC guidelines	871	671	1542 Km
Portion of THLB managed as a Protected Areas/parks/rec areas (ha)	485 (Atlatzi R, Kingcome R and Thurston Bay Marine)	89,128 (Fiordland, Kitlope, Tweedsmuir)	89,613 ha
Deferrals		28	28

There is considerable debate as to the adequacy of protection provided by the Forest Practices Code. Ongoing problems largely associated with historical forestry development include increased sediment supply, channel bank erosion, channel instability and the lack of natural riparian vegetation. Primary issues that are presently being discussed and debated are acceptable rates of cut as well as adequate riparian reserve zone requirements. Improved protection for fish habitat within the CCLCRMP could be achieved by determining the rate of cut on a watershed basis. As well, islands should be viewed as individual watersheds as opposed to being included within a larger area used for managing harvest levels.

DFO and BCE habitat personnel have concerns over the ability of the FPC guidelines to provide adequate protection for small fish-bearing streams (Reid, pers. comm.; Chambers, pers. comm.; Koroluk, pers. comm.; Liepens pers. comm.). The FPC guidelines does not require a reserve zone for fish bearing streams less than 1.5 meters in width (S4) but includes a management zone that may have anywhere from 0 - 100% retention, depending on site specific conditions and professional judgment. Although the current FPC guidelines may provide some flexibility for prescribing protective measures for small streams, riparian protection has not been adequate due to a lack of understanding and recognition of issues associated with the importance of sustaining riparian function. To address these concerns, DFO, MOF, and MELP have organized a multi agency committee to review this issue with the goal of identifying any shortcomings in Code implementation for protecting S4 fish streams. Results from the coastal assessment will not be available until late 2001.

In general, forest harvesting practices in valley bottom areas where both timber values and fish habitat overlap could be improved. More accurate identification of fish streams within the floodplain area as well as maintaining access to important off channel high water refuge habitat is critical for sustaining existing fisheries values. Recognition of the downstream impacts of forestry development in the upper watershed area, adjacent to non-fish bearing reaches would also assist in sustaining fisheries and water values throughout the watershed.

According to the DFO sensitive watershed analysis, the protection of sensitive fisheries and riparian values will need a more watershed based approach when establishing resource development plans, rather than applying the minimum standards outlined by the FPC guidelines. Site specific management recommendations are needed to address terrain stability and/or sedimentation concerns as well as sensitive floodplain or riparian issues in several watersheds including Clear River, Atlatzi River, Franklin River and Klinaklini River. These high value watersheds are suggested target areas for compliance monitoring and enforcement. Other areas that are unlogged to date with high fisheries values, such as Roscoe Creek may require more enhanced protection in order to sustain existing fish and fish habitat values. Specific concerns associated with riparian degradation, terrain instability, hydrologic concerns, sensitive fish habitat etc are identified for each high sensitive watershed in the analysis completed by DFO (DFO 2000a).

Protection of fish and fish habitat could be improved for numerous streams where salmonid abundance and distribution information is unavailable, if all streams with less than 20% gradient are treated as high value fish streams unless otherwise designated by detailed fish inventory work or by DFO/BCE personnel. Fisheries sensitive zones, including those that exist on floodplains, have poor protection (Liepens, pers. comm). Improved recognition and identification of fisheries sensitive zones including high water winter refuge habitat and wetlands in addition to increasing the minimum 5-metre machine-free zone would improve protection of seasonal off-channel habitat (Liepens, pers. comm). In the northern plan area, the protection of freshwater fish habitat could be improved with the completion of a Lakes Classification System, the identification of temperature-sensitive streams and special management of rare and very productive limestone-rich areas (Liepens, pers. comm.).

More effort is required to assess compliance to the existing FPC guidelines and it has been suggested that at least 10% of all cutblocks should be evaluated on a annual basis (Reid, pers comm.). The assessment should include sediment sampling and evaluate current sediment delivery rates. The allocation of personnel and funding to BCE is critical for assessing compliance to existing guidelines. Additional funding/personnel to BCE and DFO to review forest development proposals would also assist in protecting fish habitat within the Plan Area.

The implementation of the proposed action plan called the Living Blueprint for BC Salmon Habitat will assist in the recovery and protection of salmonid habitat. This action plan proposes a province-wide policy and strategy on salmonid productivity, focussing on habitat management, habitat protection, stream restoration and salmonid enhancement (Buchanan *et al.* 1998). The long-term vision of this plan is to decentralize regulatory powers by delegating to local people though accountable watershed management committees, responsibilities and authority to implement management plans for habitat and fish production.

Another strategy to promote the recovery and/or sustenance of anadromous salmonid stocks is to designate federal and provincial Crown lands in key estuaries under the Pacific Estuary Conservation Program and set aside or purchase key riparian lands (Buchanan *et al.* 1998). The establishment of land-based protected areas will also assist in protecting fish habitat and sustain freshwater productivity. Protected watersheds in the southern Plan Area by the provincial Protected Areas Strategy initiative include the Ahta River, Anhuatti River, Kwalte River and the Kakweiken River (Chambers, pers. comm). In September 1996, the Bella Coola/Atnarko River system was nominated by the Canadian Heritage Rivers Board and recognized by the provincial government (BCHRB 1997).

The Watershed Restoration Program (WRP) is an ongoing provincial initiative to restore the productive capacity of fisheries, forest and aquatic resources that have been adversely affected by past forest harvesting practices (Johnston and Slaney 1996). The program decreases the recovery time of degraded fish habitat by re-establishing conditions found in natural, undisturbed watersheds. Within the CCLCRMP study area, the Watershed Restoration Program has provided over $1 million of funding for fish habitat and riparian assessments, fish inventories and enumeration projects and mapping in over 9 watersheds during 1996/1997 fiscal year. Almost $1.4 million was provided by the WRP in 1997/1998 to assess and restore watersheds that had been negatively affected by forestry development. Major projects included fisheries inventory work in Rivers Inlet, an overview assessment, steelhead enumeration, mapping and stream restoration in the Bella Coola River and a terrestrial ecosystem mapping project at Ellerslie Lake.

36. Salmon Escapement, Catch and Total Stock Trends

36.1 Background/Current Status

Within the CCLCRMP Plan Area, salmon escapement data is collected annually from many streams, including selected "indicator streams" for each DFO statistical area (Fig 1). These streams have been used for at least three decades (1950's – 1970's) as indicators for in-season management as well as post-season indicators of management success. Total escapement from indicator streams is thought to comprise a significant proportion of the total area escapement (Goruk, pers. comm).

The reliability of escapement data is highly variable, depending on the species, enumeration method, and variations in stream conditions, river size and access. Establishing escapement trends from historical escapement information is complicated by changes in enumeration methodology and varying effort over time. It is important to note that escapement data alone cannot be used as an indicator of total stock size, but only reflects the number of returning spawners. For the purposes of this report, escapement and catch data is reported from managed systems with reliable information.

Escapement and commercial catch statistics for salmon are reported for the CCLCRMP area according to DFO's statistical management areas. Statistical Areas 7-11 and a portion of Areas 6 and 12 are located within the Plan Area. The northern portion of the Plan Area encompasses part of Area 6 (north), as well as Statistical Areas 7 through 9. The southern Plan Area includes Areas 10, 11 and a portion of Area 12. Escapement information is available for all 5 salmon species but commercial catch data is available for only commercially targeted stocks that include selected pink, chum, sockeye and chinook runs.

36.1.1 Pink salmon (*Oncorhynchus gorbuscha*)

Pink salmon are the most abundant and smallest-sized species of Pacific salmon, averaging 1.0 to 2.5 kilograms. Pinks have the simplest 2-year life cycle, where upon emergence, pink fry migrate directly to sea. The juveniles grow rapidly, making extensive feeding migrations and returning to their natal river after 18 months in the marine environment (Heard 1991). Due to the fixed two-year life cycle, pink stocks in odd and even years are genetically distinct from one another.

There are over 130 streams within the Central Coast (Areas 7-10) that support both odd- and even-year pink salmon stocks. In general, total returns of even-year pink runs have been larger than odd-year stocks. The majority (75%) of pink salmon is produced in Area 8 (north), with the Bella Coola/Atnarko River system accounting for the largest population. Approximately 50% of the total Central Coast pinks return to the Bella Coola/Atnarko system with recent escapements reaching 2 to 3 million fish (1990-1996) (Table 3). The Snootli Creek facility contributes to the pink production, with the operation of the Atnarko spawning channel which is estimated to produce an estimated average of over 800 000 pink fry each year between 1986 and 1997 (Bailey pers. comm). Also within Area 8 (north), the Kwatna River, Koeye River and Kimsquit River produce significant runs of 200,000 to 300,000 pinks annually. Pink production in Areas 7 (north) and 9 (north) are similar but Area 7 (north) pinks originate from numerous small populations whereas Area 9 (north) has 2 large runs returning to the Chuckwalla River and Kilbella River. Pink production in Area 10 (south) is comparatively low, with fewer than 10 small pink stocks.

36.1.1.1.1.1 Table 38. Primary pink-producing systems and average production within Areas 7-10 (DFO 1997).

System	Area	Average Proportion of pink production within Areas 7-10	Average Area Escapement

System	Area	Average Proportion of pink production within Areas 7-10	Average Area Escapement
Bella Coola/Atnarko	8 (north)	50%	2-3 million
Kwatna/Koeye/Kimsquit	8 (north)	*Also important pink producing systems*	N/a
Chuckwalla/Kilbella	9 (north)	N/a	200,000 – 300,000
60 streams with small populations	7 (north)	N/a	200,000 – 300,000
Fewer than 10 pink-producing systems	10 (south)	N/a	

Commercial catch of Central Coast pink salmon represents an important component of the BC fishery, with a record high catch of 13.5 million pinks in 1962 (DFO 1997). Average catch by decade shows a downward trend during the 1970's but odd-year catch levels fully recovered in the decade between 1981-1990 to equal 1961-1970 catch levels. The even-year pink catch between 1981-1990 has also recovered to 59% (3.4 million fish) of the 1961-1970 harvest levels (Fig 6).

The primary pink fisheries within the CCLCRMP Plan Area are the Bella Coola/Atnarko River stock and to a lesser degree the Koeye River stock in Area 8 (north). Limited commercial fishing opportunities for a small fleet are provided by Area 7 (north) pink stocks and commercial fisheries are limited to small targeted fisheries in Areas 9 (north) and 10 (south) only when escapement goals have been achieved. Both Native and sport fisheries capture pink salmon but there is no targeted Native food fishery for pink salmon in the Central Coast Plan Area (DFO 1997).

Returns of odd- and even-year pink salmon to the Central Coast have been highly variable over the past 36 years (DFO 1997). Total pink stocks (catch and escapement) peaked in 1962, showed a declining trend to 1982, and then recovered to another peak in both catch and escapement by 1988. Most recently, total pink stock (catch + escapement) has declined from a peak in 1988 of over 15 million fish to approximately 1 million in 1994. 1996 escapements indicate that populations throughout the Central Coast are starting to recover with the exception of Area 10 pink stocks (south) (Fig 7a,b,c) (DFO 1997; Wood *et al.*1997).

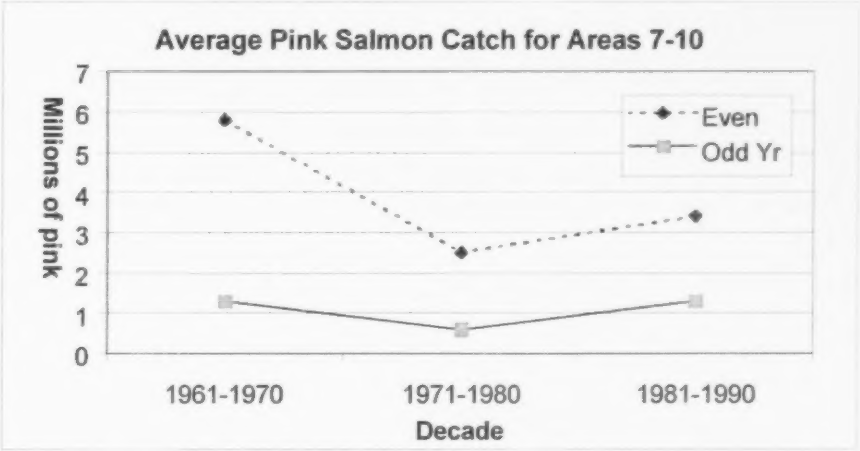
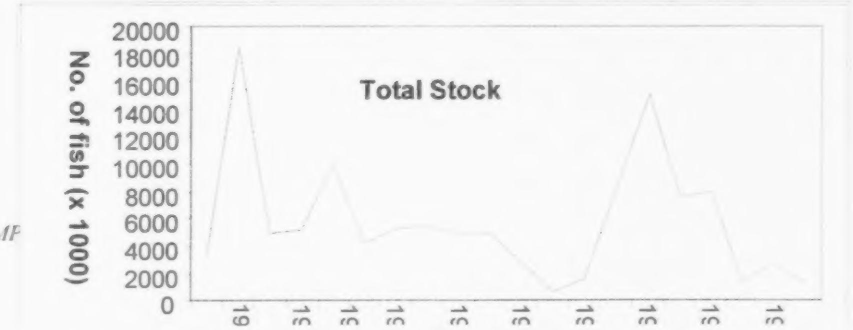
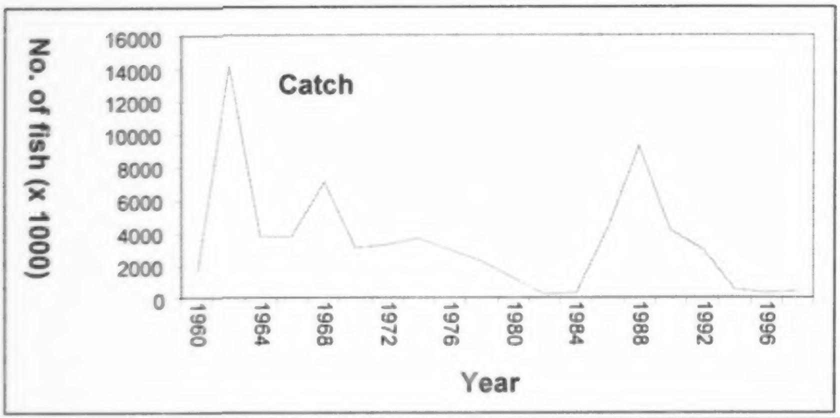


Figure 6. Average odd and even year pink commercial catch by decade for Statistical Areas 7-10 (DFO 1997).





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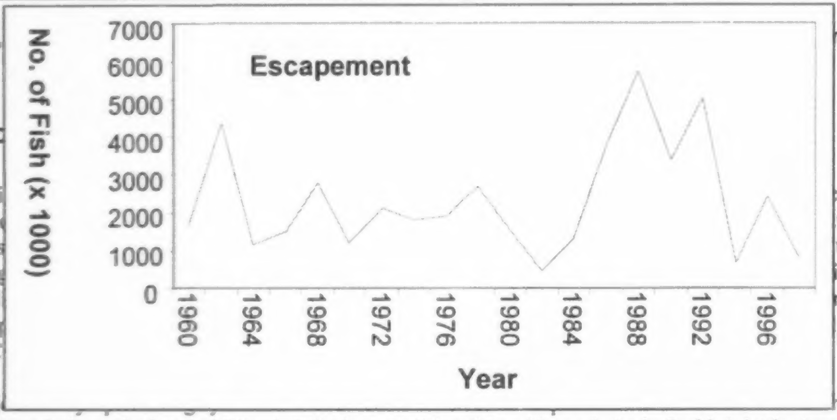

36.1.2 Sc

Sockeye exhi ally rear in
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The four maj in Area 8 (north), Owikeno Lake at the head of River's Inlet in Area 9 (north) and Long Lake in Smith Inlet in Area 10 (south) (Wood *et al.* 1997). In Statistical Area 8 (north), the majority of sockeye are produced in the Bella Coola/Atnarko system and the Kimsquit River. The total stock (escapement + catch) equaled 197,224 sockeye between 1960-1979 and declined to 150,099 between 1980-1998. Annual escapement to Area 8 (north) has remained relatively similar ranging from 53,542 between 1960-1979 to 47,324 between 1980-1998 (Fig 8) (DFO 1998c).

Sockeye are also produced in numerous other systems throughout the Central Coast Plan Area. Some of these include the Koeye River, Namu River and Dean River where average annual escapements have been less than 1000 fish since 1990. Escapement for the Kimsquit and Atnarko stocks show no obvious long term trend (Wood *et al.* 1997).

Rivers Inlet sockeye (Area 9 north) spawn in at least 12 tributaries to Owikeno Lake and are managed as a single stock. Sockeye production is limited by low productivity due to glacial turbidity of the lake, and sockeye returns averaged 924,000 fish between 1948 and 1991 (Rutherford 1997) (Fig 9). Since 1992, total sockeye returns (escapement + catch) to Owikeno Lake have been declining and returns since 1994 have been at or near record low levels (Wood *et al.* 1997). Recent poor escapement levels are likely the result of five consecutive years of poor marine survival (brood years[79] 1990-1994) because recent data has identified that there has been no overall decline in freshwater survival or pre-smolt production (Rutherford *et al.* 1995).

Although Rivers Inlet sockeye escapement increased in 1997, allowing the minimum target escapement of 200,000 sockeye to be achieved, the total stock in 1997 was well below the pre-1992 average of 924,000 fish, implying continued poor (marine) survival (Rutherford *et al.* 1998).

Smith Inlet (Area 10 south) sockeye spawn in tributaries to Long Lake where productivity of this lake is limited by the low availability of nutrients. From 1976 to 1997, with the exception of 1980 and 1981, Long Lake has been artificially fertilized to enhance productivity. Sockeye escapement and juvenile recruitment are monitored in the Long Lake system and the Docee River counting fence was constructed in 1972 to allow reliable in-season enumeration of escapement (Bachen *et al.* 1997). Total returns have averaged 333,000 fish since 1972 (Rutherford 1997). After the escapement target was increased in 1979, spawning escapement doubled. Total sockeye returns (catch + escapement) increased with records of over 800,000 and 900,000 fish as recently as 1991/1992 (Rutherford 1997, Fig 10). However, recent total returns have declined due to poor marine survival and have reached near record low levels in 1994, 1995 and 1996 (Wood *et al.* 1997). Poor escapement levels in 1995 and 1996 have been attributed to poor marine survival of the 1991 brood year (Rutherford *et al.* 1995). Recent marine conditions are considered to be anomalies and are expected to return to normal in the near future.
Escapements in 1999 were the lowest recorded to date with Rivers and Smith Inlet escapements estimated at 3,600 and 5,900 respectively (DFO 2000c). Future returns to Rivers Inlet are expected to be low through 2001 as a result of very poor escapements from 1994 to 1996 (Rutherford *et al.* 1998). Similarly, poor sockeye escapement to Smith Inlet from 1995 to 1997 is expected to yield poor returns through 2002. Fishery management plans will be developed by DFO assuming poor survival rates and predicted low returns.

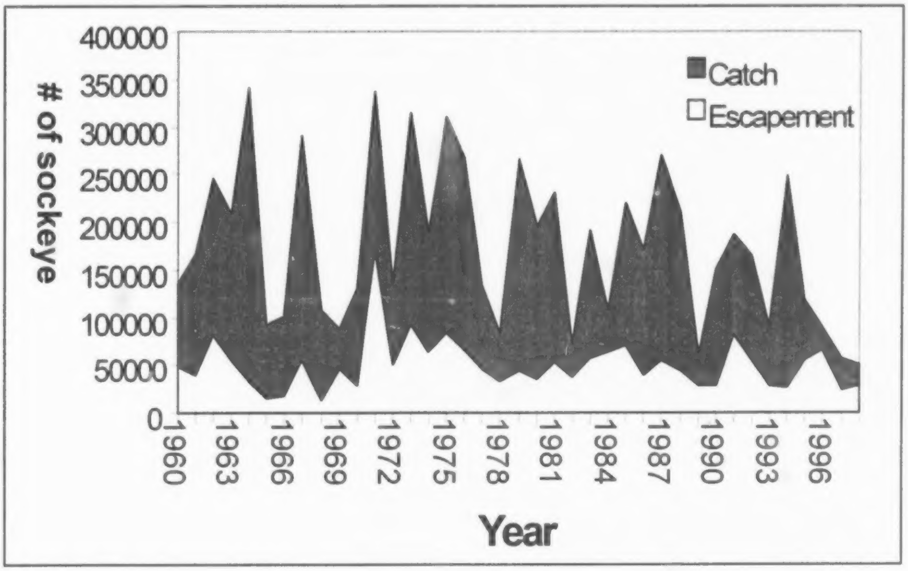

Figure 8. Total stock, catch and escapement for Area 8 (north) sockeye (Kimsquit River and Bella Coola/Atnarko system) between 1960-1998 (DFO 1998c).

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[79] Brood year refers to the year adult spawners returned to their natal stream.

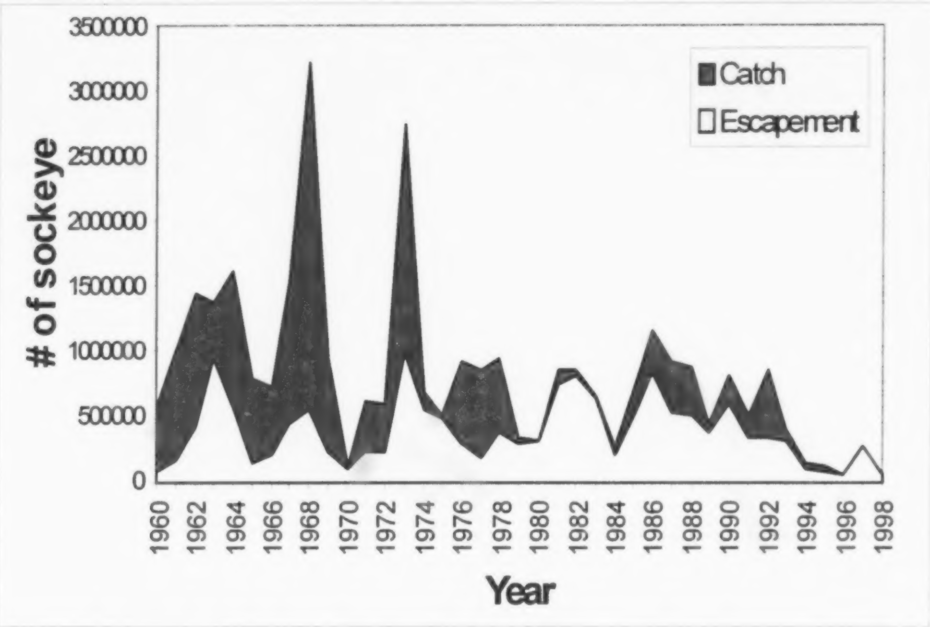


Figure 9. Total returns, catch and escapement for Rivers Inlet (Area 9 north) sockeye (DFO 1998c).

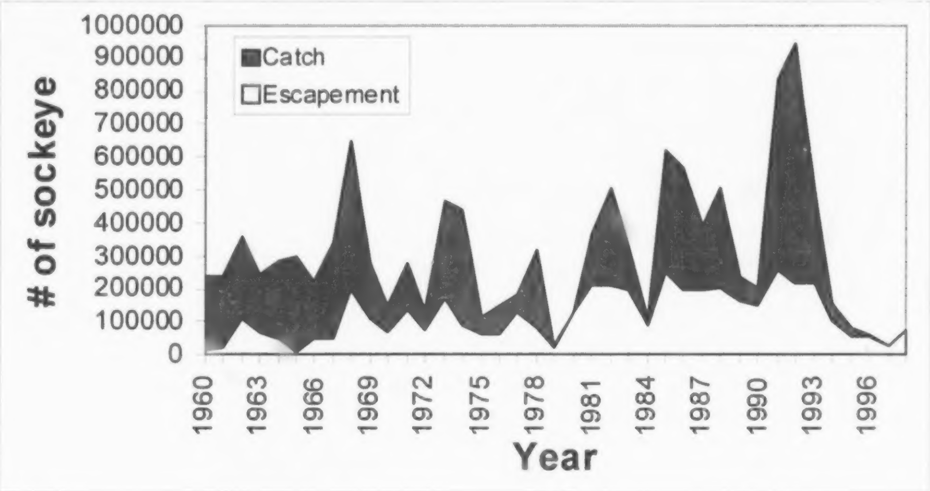


Figure 10. Total returns, catch and escapement for Smith Inlet (Area 10 south) sockeye. (DFO 1998c).

The commercial sockeye fishery on Smith and Rivers Inlet stocks started as an inlet fishery at the turn of the century. With the mechanization of fish boats, the fishery moved further offshore. Starting in the early 1970's, fishing boundaries were established to create a more terminal fishery in the inlets. Between 1916 and 1975, the average commercial catch of Rivers Inlet sockeye varied from 726,000 to 946,000 pieces (Rutherford 1997; Table 4). In 1979, an adaptive management plan was implemented and the average annual catch was reduced to 150,000 from 1979 to 1996 in order to achieve a minimum escapement target of 200,000 sockeye (Walters *et al.* 1993). Due to recent declines in escapement, the commercial fishery was closed in Area 10 (south) in 1997 and Area 9 (north) has been closed since 1996 (DFO 1998c).

36.1.2.1.1.1 Table 39. Average commercial catch of sockeye salmon in Smith Inlet (Area 10 south) and Rivers Inlet (Area 9 north) between 1916 and 1995 (Rutherford 1997).

Years	Average commercial catch in Smith Inlet (Area 10 south)	Average commercial catch in River's Inlet (Area 9 north)
1916-1925	--------	848,000
1926-1935	--------	864,000
1936-1945	--------	726,000
1946-1955	--------	946,000
1956-1965	223,000	743,000
1966-1975	206,000	781,000
1976-1985	136,000	229,000
1986-1995	265,000	225,000

Between 1956 and 1975, the average commercial catch of Smith Inlet sockeye ranged from 206,000 to 223,000 pieces (Rutherford 1997) (Table 4). Average annual catch declined to 162,000 sockeye between 1972 and 1978. Between 1979 and 1996, the commercial catch averaged 202,000 sockeye but 1995 and 1996 catches were unusually low due to poor marine survival of the 1990 and 1991 brood years (Rutherford 1997).

36.1.3 Chum (*Oncorhynchus keta*)

Chum salmon spawn in streams and after emergence in the spring, fry immediately begin their seaward migration. The maturing adults typically return to their natal streams at age 4, reaching an average weight of 4.92 kilograms in the Central Coast area (Salo 1991).

Prior to the mid-1970s, Area 7 (north) produced the largest number of chum salmon within Statistical Areas 7 to 10 with a peak in total stock (catch + escapement) of approximately 1.67 million fish in 1973 (Fig 7). Primary chum-producing systems include Roscoe Creek, Kainet Creek, Neekas River, and Kwakusdis River. By the late 1970's, both escapement and catch declined in Area 7 (north) while Area 8 (north) chum stocks were increasing. Over the last 20 years, the mean escapement of Area 7 (north) chum has been 162,000 fish and 1998 total target escapement for key streams equals 243,500 fish (DFO 1998c). Area 7 has been enhanced with chum fry releases from Bella Bella Hatchery, especially into McLauglin Bay which received an average of 780 000 fry annually between 1981-98, and Klemtu Hatchery with releases into Trout Bay averaging 357 000 fry annually between 1984-98.

Since 1979, Area 8 (north) has produced the greatest number of chum salmon with the total stock (catch + escapement) averaging 593,300 fish over the last 20 years (DFO 1998c). The primary chum-producing systems within Area 8 (north) are the Bella Coola River and the Kimsquit River where target escapements equal 80,000 and 60,000 respectively (DFO 1998c). In Statistical Area 8 (north) the total stock of chum salmon peaked in 1986 at over 1.7 million fish, allowing a commercial fishery of 1.5 million chum and an escapement of over 266,000 fish (Fig 8). The total target escapement for chum returning to DFO's "key streams" has been set at 193,000 fish annually (DFO 1998c). In general, chum in Area 8 (north) show an increasing trend in both catch and escapement (Fig 8).

Snootli Hatchery began chum releases into the Bella Coola River in the 1979 brood year averaging 2.7 million for the first 4 years. Once at full production, the hatchery has averaged releases of 7.2 million fry since 1983. Since 1983, Snootli Hatchery has been a significant contributor to Area 8 chum catch and escapement averaging 116,000 to the catch and 20,400 to the escapement. This contribution peaked at 427,000 catch in 1988. Operation of the hatchery has been a significant factor in the increasing trend in catch and escapement of Area 8 chum stocks (Bailey, pers. comm).

Chum production in Areas 9 and 10 is considerably lower than Areas 7 and 8. In Area 9 (north), chum catch and escapement peaked in 1986 with a total stock of approximately 356,700 fish, of which 155,500 (44%) were harvested by the commercial fishery and 201,200 (56%) escaped to their natal streams (Fig. 9)(DFO 1998c). Primary chum-producing systems within Statistical Area 9 (north) include the Wannock River, the Clyak/Neil/Young system, Draney Creek, Chuckwalla River and the Lockhardt/Gordon system where target escapements total approximately 100,000 fish (DFO 1998c). Over the past 20 years, the average escapement for Area 9 (north) has been 56,883 chum. Both escapement and commercial catch have remained relatively unchanged since 1960.

Chum production in Area 10 (south) is slightly lower than Area 9 (north), with an average total stock (escapement + catch) of approximately 43,400 fish over the past 20 years. The total stock peaked in 1973 with 114,800 fish, of which 71,500 (62%) adults escaped to spawn in their natal stream (Fig. 10). The majority of chum are produced in the Nekite River, the Nekite spawning channel and the Takush River where target escapements equal 60,000, 16,000 and 15,000 fish respectively. Target escapements for key streams total over 91,000 but the average escapement over the past 20 years has been approximately 33,100 fish (DFO 1998c).

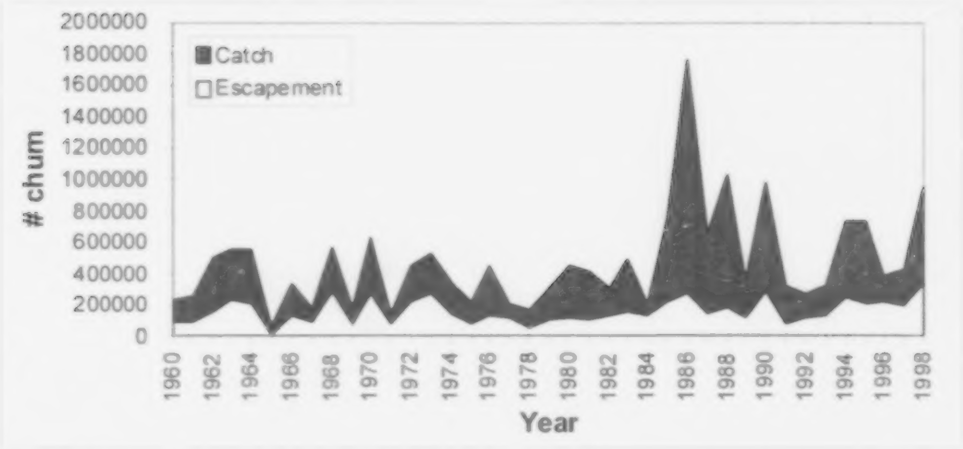


Figure 7. Catch and escapement for Area 7 (north) chum from 1960 to 1998 (DFO 1998c).

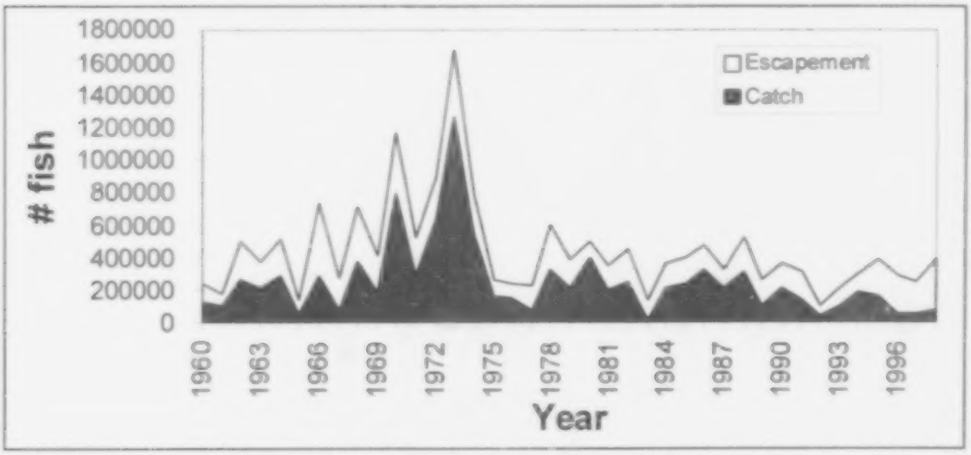


Figure 8. Catch and escapement for Area 8 (north) chum between 1960 and 1998 (DFO 1998c).

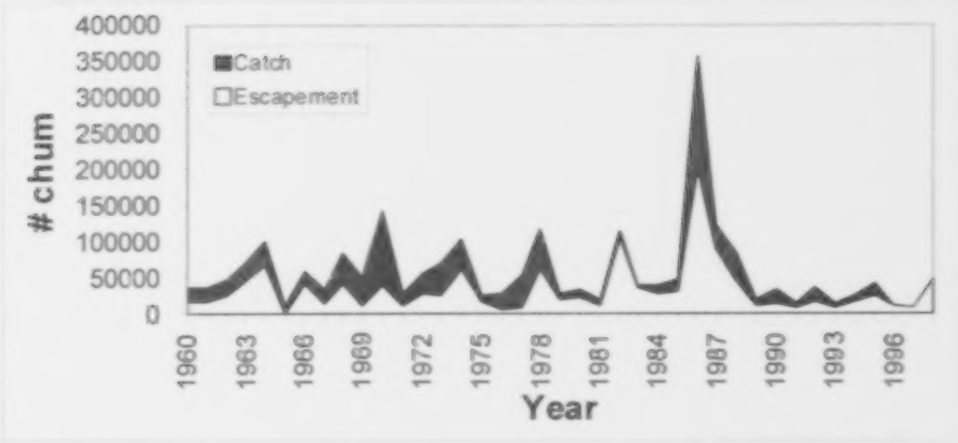


Figure 9. Catch and escapement for Area 9 (north) chum between 1960 and 1998 (DFO 1998c).

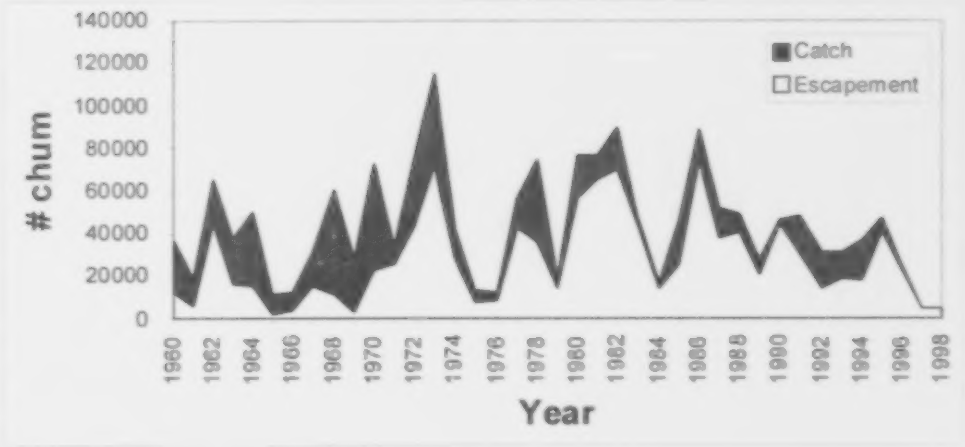


Figure 10. Catch and escapement for Area 10 (south) chum between 1960 and 1998 (DFO 1998c).

36.1.4 Coho (*Oncorhynchus kisutch*)

(The majority of this chapter has been submitted by B. Holtby, DFO coho biologist, Pacific Biological Station, Nanaimo, B.C.)

Coho spawn during the fall/early winter and are usually the latest spawning stocks in most systems. Fry typically remain in freshwater for one year prior to migrating to sea as smolts in the spring. Coho spend approximately 18 months in the ocean before returning to spawn as three-year-olds. Many variations to this life history pattern have evolved in response to selective pressures or environmental conditions including water temperature (Sandercock 1991). In general, lower stream water temperatures result in slower growth and development rates, thereby increasing the freshwater residence time of juvenile coho.

Estimates of escapement to individual streams in the Plan Area have been made since at least 1950. These estimates are mostly based on visual inspections of streams (Holtby, pers. comm). Coho are the most difficult salmon species to enumerate due to: their prolonged spawn timing that occurs from October through December; difficulty in access to numerous small creeks preferred by coho; and limited visibility of spawners during high fall flows or under layers of ice. DFO's enumeration program includes "key coho-producing streams" but escapement estimates do not include the numerous small, yet significant coho streams that are often difficult to access. Recorded escapement is also affected by varying levels of effort as well as the number of streams included in the enumeration program. Therefore, very few of the records are continuous and during the 1990's, the number of streams enumerated for coho in the Plan Area was significantly reduced. All of these factors make it difficult to interpret the escapement records.

Statistical Area 8 (north) produces the largest coho escapement within Areas 7 to 10 with an annual recorded escapement ranging from 1,000 fish (1995) to a maximum of 117,200 (1954) adults (DFO 1998c). Coho escapement data in Area 8 (north) are collected from 35 key streams, with the Bella Coola River and Dean Channel representing the two primary coho systems. Statistical Area 7 (north) produces the second highest coho escapement that ranges between 600 (1995) and 31,200 (1955) spawners (DFO 1998c).

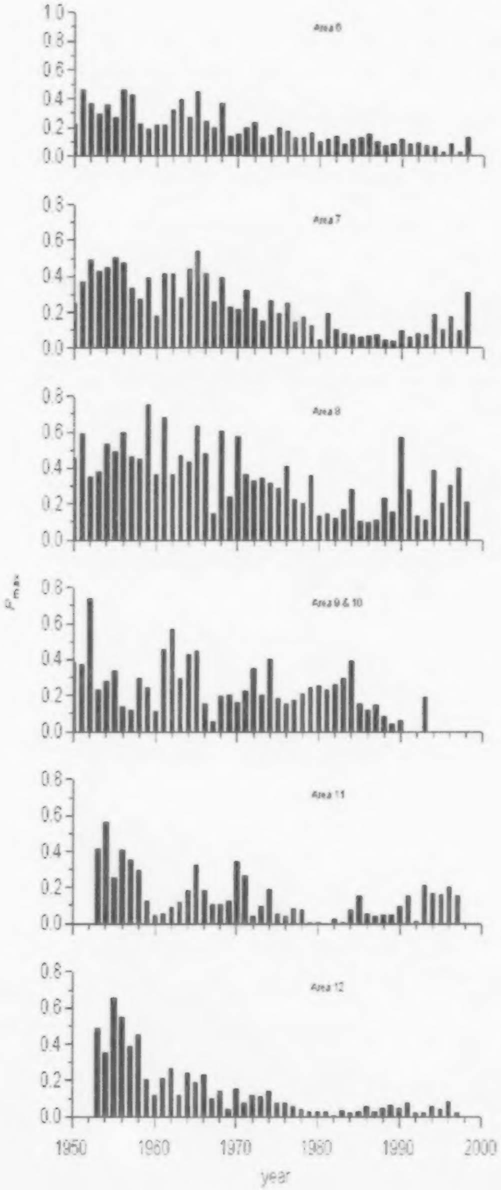
To extract what information the escapement surveys do contain, streams in Statistical 6 to 13 were selected if there were at least 10 observations between 1950 and 1998. The maximum recorded escapement in each stream was then noted. The annual escapement in each stream was then divided by the maximum escapement recorded and the estimation was recorded. This procedure scaled the annual escapement in each stream to a value between 0 and 1. This scaled escapement was then averaged within each year over all of the streams within a Statistical Area to give an index of the escapement, called p_{max}, which ranged from 0 to 1 (Fig 11). This procedure was carried out for the stream of Statistical Areas 6 to 13. Streams in Areas 9 and 10 were pooled because very few systems were enumerated. Data from these Statistical Areas are the most uncertain.

Although there is a lot of uncertainty about the escapement record there are some geographical patterns and common features. Escapement in the 1950's and 1960's were generally higher than they have been in the 1990's (Fig 11). Currently coho escapement is lowest in the extreme north and south portions of the Plan Area. Escapement in Areas 7, 8 and 11 were lowest during the early to mid-1980's but have since increased so that in Areas 7 and 8, escapement is approaching levels seen in the 1950's. The timing of the decline in the 1980's seems to be later in the northern areas where recoveries were more rapid and extensive. The early 1980's was a period of rapid increase in coho exploitation rates in northern Canadian and Alaskan troll fisheries and might account for the decreased escapement during that period. However, there have not been decreases in exploitation rates in the same fisheries that could account for the increases to escapement in the 1990's. Changes in escapement could have been due to fluctuations in marine or freshwater survival, but there are no survival measures for coho in the Plan Area, so this possibility cannot be readily investigated.

Coho runs have been enhanced on the Central Coast throughout the 1980s and 90s by the facilities at Snootli Creek, Scott Cove Creek, Bella Coola River, Shotbolt Bay, Glendale Channel, Warner Bay Creek, Gillard Pass, Heiltsuk, and Klemtu Creek. The most significant numbers of fry and smolts released per year have averaged 59 000 from the Heiltsuk between 1982-97, 56 000 from Klemtu Creek between 1983-98, 127 000 from Scott Cove Creek between 1982-98, and 513 000 from Snootli Creek between 1981-97 (Bailey, pers. comm).

Over 80% of the coho taken in ocean fisheries, excluding terminal net fisheries are caught in the highly mixed-stock troll fisheries in northern British Columbia and Alaska. The proportion taken in Alaskan fisheries increases from about 50% for stocks in the southern Plan area to about 65% for stocks in the north. There are no measures of total exploitation rates for Central Coast stocks, but the timing and pattern of catches is similar to more northern stocks where total exploitation rates are between 60% and 75%, most of which is exerted by the troll fisheries.

Figure 11. Trends in coho escapement indices for Areas 6 through 12 between 1950-1998 (Holtby, pers. comm).

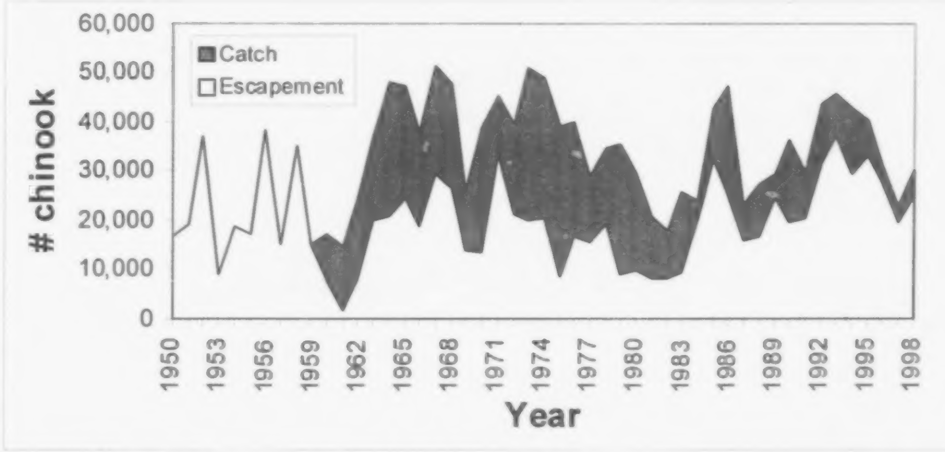


36.1.5 Chinook (*Oncorhynchus tshawytscha*)

Chinook are the largest Pacific salmon species in terms of individual size, reaching up to 45 kilograms in weight. Chinook spawn during the summer and fall, with fry emerging in the spring similar to all other salmon species. However, the freshwater life history phase of chinook is varied, with the two main races being either "stream-type" or "ocean-type". Stream-type chinook spend at least one year in freshwater prior to migrating to sea and return to their natal stream several months prior to spawning as 4, 5 or 6 year olds. Ocean-type chinook fry migrate to sea within the first year, usually within 90 days after emergence, and return with only a few days or weeks prior to spawning as 4, 5 or 6-year-olds (Healey 1991).

Statistical Area 8 (north) produces the largest number of chinook, with an average escapement of approximately 20,500 fish recorded over a 20-year period between 1977-1997 (DFO 1998c). Chinook escapement peaked in 1956 with a total of 38,500 fish and although escapement data exhibits annual variability, the 20-year averages (1950-1977 vs 1978-1997) have remained relatively consistent through 1997 (Fig 12). The Bella Coola River is the primary chinook-producing system within Area 8 (north), and accounts for 91% of the total chinook escapement between 1990 to 1997. Escapement to the Dean River usually ranges between 1000 and 2000 adults, while escapement to other chinook systems (Kimsquit, Kwatna and Taleomey Rivers) has generally been fewer than 1000 fish. The Atnarko spawning channel was constructed in 1986 to enhance chinook spawning habitat and escapements average 525 between 1990 to 1997. The Snootli Hatchery has operated a fry outplanting program since the 1980's.

Figure 12. Terminal Catch and escapement for Area 8 (north) chinook between 1950 to 1998 (DFO 1998c).



(No catch info listed between 1950-1960 and therefore graphed as zero).

Thc inook
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Snootli into a variety of systems within Area 8 but particularly the Atnarko River. It has also produced juveniles for the Oweekeno Hatchery for release back into the Wannock River and for Shotbolt Bay Hatchery for release into the Chuckwalla and Kilbella Rivers (Bailey, pers. comm.).

Chinook escapement to Area 9 (north) averaged 4,850 fish annually between 1978-1997 (DFO 1998c). The majority of chinook are produced in the Wannock River where an average of 7,100 spawners returned annually between 1990 to 1997. Enumeration is complicated due to the large size of the river, combined with high natural sediment loads that obscure visibility. Beginning in 1985, the Wannock River chinook have been enhanced annually with broodstock captures during the fall and a fry outplanting program during the spring (Goruk, pers. comm). Wannock chinook stocks are one of the largest-sized fish produced within BC (Goruk, pers. comm). While historically, fewer than 500 adults haven been observed in the Chuckwalla and Kilbella Rivers, recent, more intensive surveys indicate escapements exceeding 500 fish in both systems. Escapement to other chinook streams, including the Neechanz, Clyak, Ashlulm and Tzeo Rivers, have generally been fewer than 300 fish, but most frequently fewer than 100. Both the Oweekeno and Shotbolt Bay facilities have enhanced Area 9 chinook, with an average of 335 000 fry released per year between 1983-96 from Oweekeno and an average release of 99 000 per year from Shotbolt Bay between 1985-97 (Bailey, pers. comm).

Area 10 (south) chinook escapement averaged almost 800 fish annually between 1978 to 1997 (DFO 1998c). The majority of chinook is produced in the Docee River, where the average escapement between 1990-1997 equaled 500 spawners. A counting fence located at the outlet of Long Lake was designed to enumerate sockeye in 1972 but is currently not managed to enumerate chinook on an annual basis. The first year for chinook and coho enumeration at the fence occurred in 1997. Annual escapement to the Nekite River averages fewer than 100 chinook. There are a few known chinook-producing streams in Area 7 (north) and the portion of Area 6 (north) that lies within the CCLCRMP Plan Area.

36.1.6 Salmonid Enhancement Projects

Within the CCLCRMP, First Nations people as well as the federal and provincial governments operate salmonid enhancement programs. Ongoing enhancement projects in the northern CCLCRMP area include Snootli Hatchery, a major hatchery for chum, chinook and coho at Bella Coola and a fishway at Canoona Creek. First Nations hatchery programs are being operated by the Hartley Band (Hartley Bay Hatchery), Kitasoo First Nation (Klemtu Hatchery), Heiltsuk First Nation (Bella Bella Hatchery) and the Oweekeno First Nation (Oweekeno Hatchery) (Bailey, pers. comm). There is also a private chinook and coho hatchery at Shotbolt Bay. In the south, enhancement facilities include a fishway at Atlatzi Falls and another in the Kakweiken River. There are at least 4 spawning channels in the southern Plan Area on the Neekite River, Kakweiken River (pink, chum, coho, steelhead) Glendale Creek (pink, chum, coho, sockeye) and the Phillips River (CCLCRMP 1998). A complete list of enhancement facilities within the Central Coast Plan Area is included in Appendix B.

36.2 Future Trends

For the Central Coast area, species escapement outlook between 1998-2001 for sockeye and coho are below average whereas chum and chinook escapement are expected to be average (DFO 1998a). Future sockeye returns to Rivers Inlet are expected to be low through 2001 as a result of very poor escapements in 1994 to 1996 (Rutherford *et al.* 1998). Similarly, poor sockeye escapement to Smith Inlet from 1995 to 1997 will yield poor returns through 2002. In the fall of 1999, DFO created a task force to address drastic declines in sockeye escapement to Owikeno Lake and Long Lake (DFO 2000b). The objective of the habitat strategy for Rivers Inlet and Smith Inlet is to "Manage Habitat to Ensure Optimal Natural Productive Capacity at all Life Stages". The recovery program will strive to protect the natural productive capacity of existing fish habitat, restore historical sockeye habitat that have been damaged and enhance habitat that is limiting for sockeye production. The commercial fishery has been closed on both Rivers Inlet and Smith Inlet sockeye stocks since 1997 (DFO 2000b).

In order to protect and rebuild endangered coho stocks, DFO has implemented a Salmon Management Plan that avoids the harvest-related mortality of coho by restricting all fisheries that affect threatened coho stocks and by promoting selective fishing techniques in other areas. Included is the Coho Recovery Plan that includes new programs for coho enhancement, habitat protection, restoration, better enforcement of regulations, and stock assessment programs to strengthen coast wide information on coho (DFO 1998b).

Even-year pink stocks on the Central Coast appear to be increasing after several cycles of low abundance. Increased total stock returns for 1997 odd-year runs in Areas 8 and 9 increased by over 50% in comparison to 1995 data (DFO

1998c). There is an existing conservative harvest management plan in place to sustain the long-term viability of pink stocks within the Central Coast (DFO 1997). Although fish harvest restrictions may appear to be the most direct strategy towards successfully rebuilding a targeted salmonid stock, this strategy is only effective if stock size is limited by spawners (Holtby, pers. comm). Some examples of harvesting restrictions include more selective fishing techniques and reduced catch levels. Improved stock assessment, an explicit policy to sustain biodiversity and better co-ordination of research initiatives can also assist in the conservation of salmonid stocks (DFO 1998a).

Recent studies have concluded that climatically driven variations in ocean productivity have a significant effect on salmonid production by decreasing the marine survival of salmonids inhabiting the North Pacific (Beamish and Bouillon 1993). Recent marine conditions are considered to be anomalies and are expected to return to normal conditions in the near future. Marine productivity can be improved by regulating resource extraction activities to minimize the deleterious effects on the resources being extracted and their marine habitats (Holtby, pers. comm). The conservation and sustainable use of marine life is one of Canada's principal oceans objectives. The Oceans Act was legislated on January 31, 1997 and promotes the integrated management of our oceans (Canada 1997).

37. Abundance and Distribution of Trout and Char

A recent independent scientific review of anadromous salmon and trout stocks in BC and the Yukon indicated that 624 stocks were at high risk, 78 at moderate risk, 230 of special concern and 142 stocks had been extirpated in this century (Slaney et. al. 1996). In addition, 43% (4172) of the stocks were unclassified due to the absence of reliable data. Habitat degradation resulting from forestry development, hydroelectric power generation and urban development were responsible for most of the 143 documented stock extinctions (Slaney *et al.* 1996). Within the Central Coast area there are at least 9 chinook stocks, 60 coho stocks, 18 sockeye, 35 pink and 40 chum stocks identified as having a high risk of extinction (Buchanan *et al.* 1998).

37.1 Background/Current Status

The mainland coast watersheds contain several special features including unique fish and wildlife populations as well as some of the most spectacular scenic landscapes in the world. Most of these streams have healthy, stable populations of large steelhead, sea run cutthroat and Dolly Varden char (Axford 1998).

37.1.1 Steelhead (Oncorhynchus gairdneri)

Primary steelhead-producing systems within the CCLCRMP Plan Area include the Dean River, Bella Coola River, Glendale, Ahnuhati, Kakweiken, Atwaykellesse and Wahpeeto River systems (Leggett, pers. comm.; Axford 1998). In the northern portion of the plan area, significant steelhead-producing systems include the Canoona River and the Triumph River which supports the most northerly known stock of summer run steelhead (Liepens, pers. comm).

The lower 48 kilometers of the Dean River supports anadromous salmonids, including steelhead and sea-run cutthroat trout. The total run size of Dean River steelhead has ranged from a low of 3,333 in 1981 to a maximum of 17,601 adults in 1986 (Fraser 1999). The average run size was 4,753 between 1988 to 1998 (Fraser 1999).

Winter steelhead populations in the Glendale, Ahnuhati, Kakweiken, Atwaykellesse, and Wahpeeto (south) have been enumerated by snorkel surveys in 1992, 1994, 1996 and 1998 (Axford 1998). Late winter steelhead populations appear to be comparable to numbers observed in past surveys, however the trend of total mean values has decreased by 32% from 37.1 fish/km in 1992 to 25.1 fish/km in 1998 (Axford 1998). Predation may be contributing to this downward trend as reports from angling guides indicated that significant numbers of seals are feeding on fish in the estuary channels, especially during low flows when fish are concentrated in the lower reaches.

BC's angling guide policy was put into place in 1990 to ensure continued quality angling, particularly on highly-value steelhead rivers. A review in May 1995 focused on the management of angling guides, with strong links made between angling guides, the classified waters system and the angling licensing system (MELP 1996b). High value freshwater sportsfishing areas include the river systems listed in Table 5. One of the finest sportsfishing rivers in the world is the Dean River (Fraser 1999). Adult steelhead enter the Dean River from late May until late September and in 1998, a total of 4054 angler days were recorded on the river. The catch per unit effort (CPUE) for steelhead in 1998 was 0.77, slightly higher from the average between 1974 to 1997 at 0.69, but lower than the CPUE of 1.06 recorded in 1997 (Fraser 1999).

The most significant efforts at steelhead enhancement occurred in the Salloomt River, where the Snootli Creek hatchery released an average of 66 498 fish per year between 1981-90 (Bailey, pers. comm).

37.1.2 Other trout and char species

Resident salmonid species produced within the Plan Area include rainbow trout, cutthroat trout, Dolly Varden char, bull trout, and Rocky Mountain whitefish (*Prosopium willamsoni*). Known resident trout and char populations are widely distributed with known resident salmonid-producing systems listed in Appendix A (CCLRMP 1998; Murray, pers comm). However, there are many unidentified watersheds that produce significant trout and char runs, and therefore all streams up to a 20% gradient should be managed as fish-bearing until an acceptable fish inventory determines the absence of resident fish species. At this time, there is little documented information on the abundance of resident trout and char species.

37.1.2.1.1.1 Table 40. List of identified high value freshwater sportsfishing locations by species for the CCLCRMP Plan Area (Murray, pers. comm., 1998; CCLCRMP 1998).

Location	Species
Klinaklini River and tributaries	AS, ST, CT, DV
Ahnuhati River	CO, CM, PK, CH, ST, RB, CT, DV
Simm Creek	CO, CM
Kwalate River	CO, CM
Kakweiken River, tributaries and Lake	CO, CM, PK, CH, ST, CT, RB, DV
Apple River	BT, CT
Stafford River and Lake	BT, CT
Homathko River	BT, CT
Ahta River	PK, CT, CM
Kingcome River and tributaries	CO, CM, PK, CH, ST, CT, DV
Wakeman River and tributaries	CO, CM, PK, CH, ST, CT, DV
Tultz Creek	RT, CM, CO
Rainbow Creek	RT
Seymour River	CO, CM, PK, CT, DV
Nekite River	CO, CM, PK, CH, ST, CT, RB, DV
Waump River	CO, CM, CT, DV
Smokehouse River	CO, SK, DV
Kwaye River	CO, CM, PK, CH, ST, CT, RB, DV
Ellerslie Lake	KO, CT
Link Lake	RT
Dean River	ST, CH, CO, CM, PK, RT, DV, CT

Note: *AS = all salmon; CO = coho; CM = chum; CH = chinook; PK = pink; SK = sockeye*
ST = steelhead ; CT = cutthroat trout; BT = bull trout; DV = Dolly Varden char;
RB = rainbow trout

In general, fish production in the southern Plan Area is limited by biophysical constraints including cold thermal regimes, low dissolved nutrient levels, glacial silt loading and a short growing season (Rimmer and Axford 1990). Streams flow in steep-sided, heavily glaciated valleys which result in extremely rapid response to rainfall or snowmelt and flash floods are common. Freshets extend through September in many systems and waters are clouded by rock flour. Streams have extremely soft, low conductivity water (Fielden and Slaney 1982). In addition, periodic flood events combined with bank erosion, substrate instability, sand and silt deposition and debris torrents further limit fish production (Rimmer and Axford 1990). A lack of productive stream lengths due to barriers also reduces fish productivity in streams within BC Fisheries (BCF's) Mainland Coast Planning Unit (Rimmer and Axford 1990). Therefore, these systems are particularly vulnerable to localized overharvest of resident and anadromous fish stocks.

37.2 Future Trends

Existing habitat protection guidelines within the southern Plan Area are inadequate in protecting fish and fish habitat values (Reid, pers comm). Ongoing problems associated with forestry development include increased sediment loads from active road and slope failures caused by historical logging practices as well as inadequate riparian protection. Increased protection of existing fish habitat could be achieved by increasing riparian reserve areas and more watershed specific guidelines for rate of cut. Forestry harvesting practices on islands between the mainland coast and Vancouver Island could have less impacts to fish and fish habitat if a rate of cut is established for the individual island. This would allow the total operable area of the island to be considered, rather than including the island within a larger Timber Harvesting Landbase.

More effort is required to assess compliance to the existing FPC guidelines and it has been suggested that at least 10% of all cutblocks should be evaluated on a annual basis (Reid, pers comm.). The assessment should include sediment sampling and evaluate current sediment delivery rates. The allocation of personnel and funding to BCE is critical for assessing compliance to existing guidelines. Additional funding/personnel to BCE and DFO to review forest development proposals would also assist in protecting fish habitat within the Plan Area.

Protection of fish and fish habitat could be improved for numerous streams where salmonid abundance and distribution information is unavailable, if all streams with less than 20% gradient are treated as high value fish streams unless otherwise designated by detailed fish inventory work or by DFO/BCE personnel. Fisheries sensitive zones, including those that exist on floodplains, have poor protection (Liepens, pers. comm). Improved recognition and identification of fisheries sensitive zones including high water winter refuge habitat and wetlands in addition to increasing the minimum 5-metre machine-free zone would improve protection of seasonal off-channel habitat (Liepens, pers. comm). In the northern plan area, the protection of freshwater fish habitat could be improved with the completion of a Lakes Classification System, the identification of temperature-sensitive streams and special management of rare and very productive limestone-rich areas (Liepens, pers. comm.).

Please refer to the future trends section in the Salmon chapter for more information.

38. Eulachon (Thaleichthys pacificus)

38.1 Background

Eulachon-producing systems on the Pacific north-west coast are limited, and consist of 15 populations within BC, 2 south of BC and 3-4 stocks in south-east Alaska. Nine primary eulachon-producing systems are present in the CCLCRMP Plan Area and include the Dean River, Kimsquit River, Taleomey River, Asseek River, Bella Coola River, Kingcome River, Wannock River, Chuckwalla/Kilbella Rivers, and Klinaklini/Franklin Rivers (CCLCRMP 1998; Berry 1998, 1996)(Fig 11). All known eulachon spawning rivers have distinct spring freshets, and most have glacial headwater areas (Hay and Joyce 1999).

Eulachon is an anadromous species, spawning in rivers and migrating offshore to feed for 2 to 5 years before returning to spawn (Hay and Joyce 1999; Hay *et al.* 1998). In BC, eulachon spawn from mid-March to mid-May, mainly in large mainland rivers and a few rivers of intermediate size in central BC (Hart 1980). In the Klinaklini River, there were three distinct runs of eulachons observed: in the first week of March; mid-April and early May (Berry 1996). It is uncertain whether eulachon return to their natal stream to spawn. In larger rivers, including the Fraser and Columbia, it is likely that many eulachon return to their natal system, but in smaller river systems within the Central Coast area, there may be a greater tendency for straying (Hay *et al.* 1998). At this time, the origin of eulachon cannot be identified through either genetic or chemical methods (Hay *et al.* 1998).

It is believed that eulachon reach their first age of maturity at the end of their third year (Hart 1980). Adult eulachons are 15-20 centimeters long and weigh 40-60 grams with females laying about 30,000 eggs (Hay and Joyce 1999). Females release eggs near the river bottom and the eggs quickly anchor to sand grains in the river bottom. At water temperatures of 4.4 to 7.2 ° C, the eggs hatch in 30-40 days into larvae that drift rapidly out into the ocean. The life history of eulachon is obscure, particularly during the post-larval stage, but it is believed that larvae and post-larvae feed on both phytoplankton and zooplankton. It is unclear if eulachon spawn more than once (Hay and Joyce 1999).

Eulachon are culturally important species and highly regarded as a food fish by First Nations people. Throughout the 19th century, eulachon was an important food source and utilized as a cultural and economic commodity among coastal Native communities (Hay *et al.* 1997).

> *"The Heiltsuk have harvested ooligans for a very long time, both for food and to render into grease. The oolichan has been in trouble for awhile, with failures of major central coast runs last year. The severe decline and failure of some runs is cause for significant alarm". Ooligans and the foods that are associated with form a significant element in defining many First Nations' identities. The ooligan is a very significant species to the Heiltsuk and our neighbors (Hogan, pers. comm).*

Eulachon adults also play an important role in the food chain, providing a food source for halibut, cod, sturgeon and dogfish as well as whales, porpoises, seals, sea lions and marine birds (Hart 1980). Young eulachon larvae and post-larvae contribute to the food source of juvenile salmonids and cod species, particularly when congregated in major estuaries (Hart 1980).

Figure 11. Map of primary eulachon producing systems within the CCLCRMP study area.

38.2 Current Status/Future Trends

Many of these stocks have experienced declines in abundance (Hay *et al.* 1998). At this time, the timing and severity of declining eulachon stocks in some central BC rivers is uncertain (Hay *et al.* 1998). The cause for declining eulachon stocks is uncertain but may be associated with spawning habitat degradation as well as widespread oceanographic changes affecting marine survival (El Nino) (Hay *et al.* 1997). In addition, eulachon are incidentally captured in the shrimp trawl fishery, and for smaller eulachon runs, the bycatch total is significant (Hay *et al.* 1998).

There is no active DFO management of commercial harvesting of eulachon in the Central Coast Plan Area. First Nations, in co-operation with DFO and other agencies, have initiated stock assessment activities in some systems. Other ongoing management activities include the assessment of changes in spawning habitat and bycatch monitoring programs (Hay and Joyce 1999).

39. CURRENT STATUS OF RESOURCE DEVELOPMENT ACTIVITIES

39.1 Forestry Development

Major licensees operating within the CCLCRMP study area include International Forest Products, MacMillan Bloedel, Western Forest Products, Timberwest and West Fraser. Other forestry companies include Little Valley Forest Products and Neechanz Logging (CCLCRMP 1998).

According to the GIS area statistics for the northern portion of the Plan Area, only 7.5% of the total land base is managed as the Timber Harvesting Land Base (THLB). Approximately 12% of the THLB or 1% of the Gross Landbase (GLB) has been logged in the past 20 years. In the southern portion of the Plan Area, 20% of the landbase is classified as THLB. There has been more forestry development in the southern plan area, with approximately 15% of the THLB or 3% of the GLB that has been logged in the past 20 years.

The proportion of the timber harvesting landbase relative to the total land base is low in both the northern (7.5%) and southern (20%) Plan Areas within the CCLCRMP. Although the proportion of the landbase available for forest harvesting is low, there is still potential for significant site specific impacts to fish habitat from forest harvesting. At the sub-basin level, if the THLB is concentrated along the valley bottom and subsequently logged over a short period of time, there is an increased risk of sedimentation from road and bridge construction, as well as removal of riparian habitat along the valley bottom. Furthermore, changes to the natural hydrologic regime can occur when a large proportion of the timber is removed from one biogeoclimatic zone over a short period of time. Significant impacts to fish habitat from historical forestry development have occurred in the Kingcome valley (since 1890's), Wakeman River, Seymour/Belize system, Klinaklini River, Kakweiken River, the Broughton Archipelago and several islands including Gilford Island and shoreline beach areas (Chambers, pers. comm). Typical impacts to these areas have included road encroachments, increased sediment loads, channel instability, bank instability, alteration of the natural hydrologic regime and streamside harvesting. Please refer to Section 2.0 Freshwater fish habitat for current impacts of forestry development on fish habitat.

Forestry development on forested islands between the central mainland coast and Vancouver Island prior to 1982 had a high potential for negative impacts to fish and fish habitat. After 1982, implementation of the Coastal Fish Forestry Guidelines reduced the potential for forestry related impacts to fish habitat. The implementation of the Forest Practices Code in 1994, has further reduced the potential for impacts of logging and roads on fish habitat. However, the current rate of cut continues to be based on a larger land area, and therefore not established independently for islands with a significant amount of merchantable forests. Therefore, under current management, an entire island could be logged over a short period of time, causing significant ecological changes to both aquatic and terrestrial resources.

39.2 Aquaculture

As of February 2000, there are 61 aquaculture tenures in the CCLCRMP area, consisting of 56 finfish tenures and 5 shellfish operations (Truscott, pers. comm). All but one of the aquaculture tenures are located in the southern portion of the Plan Area. The total area occupied by finfish culture (551.5 ha) and shellfish culture (14.4 ha) represents 0.03% of the total marine area included in the Central Coast Plan Area (Truscott, pers. comm). The Central Coast operations account for approximately 45% of the total value of 155 million (1996) of all salmon farmed in the province (see Part I Socio-Economic Base Case for further details).

Biologists have observed that small numbers of Atlantic salmon have spawned in a few streams on Northern Vancouver Island, raising concerns over the potential for negative ecological interactions between escaped farmed fish and wild fish and their habitat. These concerns include colonization of escaped farmed Pacific salmon and the resulting risk of genetic damage to wild stocks. Interbreeding between wild and farm stock also has the potential to disrupt locally adapted gene complexes (Holtby, pers comm). The Ministry of Agriculture, Food and Fisheries (BC Fisheries) views the escape of farmed fish to be unacceptable and is pursuing a zero escape goal. BC Fisheries has been working with the aquaculture industry, the Ministry of Environment, Lands and Parks and the Department of Fisheries and Oceans to implement the recently announced escape response plan, including standards and regulations. This also includes improved monitoring of escaped farmed salmon.

Further concerns include increased competition for food sources and spawning/rearing habitat in both marine and freshwater environments between wild and escaped farm fish. There is also potential for farm fish to introduce exotic diseases to wild stocks and introduce wastes from fish farm operations into the marine environment.

According to provincial Ministry of Fisheries (originally MAFF), there is significant potential for expansion of aquaculture in the Plan Area. For salmon farming, the initial focus will be to determine what farms require relocation under the recent salmon aquaculture policy (Truscott, pers. comm). The location of relocated tenures or new pilot research and development sites, if any are proposed in the plan areas, will be determined by environmental and biophysical capability, suitability and existing protected areas. These factors will significantly constrain development in the southern portions of the plan area. Future development of new sites will be determined by future policy direction in late 2001. If any new development is allowed, the location of farms will also be constrained by capability, suitability and existing protected areas (Truscott, pers. comm).

39.3 Other Resource Development Activities

The potential impacts of settlement areas, mining and agricultural development on fish habitat are limited within the CCLCRMP Plan Area (Reid, pers. comm.; Koroluk, pers. comm.). The Bella Coola River has the most concentrated agricultural development activity along the valley bottom area, but only small, site-specific impacts to natural riparian habitat have occurred from settlement areas and small farms. Furthermore, there are no major water withdrawals, water diversions or extreme summer low flow conditions that are negatively affecting the existing quality of fish habitat in this part of the plan area.

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APPENDIX A: KNOWN RESIDENT SALMONID PRODUCING SYSTEMS WITHIN THE CCLCRMP PLAN AREA (CCLCRMP 1998, MURRAY, PERS. COMM).

Planning Unit/System	**Species**
N3	ST, CT, DV throughout
N4	ST, CT, DV throughout
Ellerslie Lake	KO, CT
N5	ST, CT, DV throughout
Link Lake	RT
Dean River, Kimsquit River	ST, RT, CT, DV
Skowquiltz River	ST, CT, DV
N9	ST, CT, DV throughout
Koeye River	ST, RT, CT, DV, BT
Nootum River	ST, CT, DV
Quatlena River	ST, CT, DV with CT and DV u/s of the barrier and in lakes.
Kwatna River	ST, CT, DV
Clyak River	ST, CT, DV .
McNare Creek, Hardy Creek	CT, DV
Twin Creek	ST, CT, DV
South Bentinck	ST, CT, DV
Clayton	CT, DV
Smitley/Noeick	ST, CT, DV
Taleomey/Asseek	ST, CT, DV
Bella Coola River	ST, CT, DV, RT, RMW, BT
N14	ST, CT, DV, BT, RT
N15	ST, CT, DV
Lockhart-Gordon	ST, CT, DV
Johnson creek	ST, CT, DV
Allard Lake	BT, RT
Nekite, Walkum	ST, CT, DV, RT
Takush River	Trout
Smokehouse Creek	ST, CT, DV and possibly BT
Docee River	Trout
Smokehouse Creek	ST, CT, possible BT
Seymour, Wakeman, Kingcome	ST, CT, DV
Atlatzi River	ST, CT, DV above and below the falls
Clear River	ST
Atwaykellesse River	ST
Seymour River	CT, DV
Tultz Creek	RT
Rainbow Creek	RT
Waump River	CT, DV
Kwaye River	ST, CT, RT, DV
Klinaklini River	ST, CT, RT, DV
Huaskin and Lee lakes	KO, CT, DV
Charles Creek	ST throughout
Ahta River	CT, DV u/s of falls
Kakweiken River and tribs	ST, CT, DV
Kakweiken Lake	RT, CT, DV
Kwalate River	ST
Ahnuhati River	ST, CT, DV, RB
Lulle Creek	CT
Apple River	ST, BT, CT
Stafford River and Lake	BT, CT
Homathko River	BT, CT

Note: AS = all salmon; CO = coho; CM = chum; CH = chinook; PK = pink; SK = sockeye
ST = steelhead ; CT = cutthroat trout; BT = bull trout; DV = Dolly Varden char;
RB = rainbow trout KO = kokanee RMW = Rocky Mtn Whitefish

APPENDIX B: ENHANCEMENT FACILITIES WITHIN THE CENTRAL COAST PLAN AREA

Fisheries and Oceans facilities are large size projects initiated, constructed, owned, operated, and maintained by Fisheries and Oceans. These include:

Snootli Creek *(F&O Major Facility)*
Atnarko River *(F&O Pilot Facility)*
Devereux Creek *(closed F&O Pilot Facility)*
Glendale Channel *(F&O spawning channel)*
Kakweiken Channel *(F&O spawning channel)*

Community Economic Development Projects (CEDP) are generally smaller projects initiated, constructed, and maintained by Fisheries and Oceans but operated by a Native Band contractor under contract to F&O. They receive most of their funding from F&O although they may have some additional sources of funding. CEDP facilities include:

Klemtu Creek *(Kitasoo Band Community Economic Development Project (CEDP) funded by F&O)*
Heiltsuk *(Bella Bella Band CEDP funded by F&O)*
Oweekeno *(F&O funded Oweekeno Band CEDP facility closed in 1995 but operated and funded since by the Oweekeno Nation)*

Public Involvement Facilities (PIP) facilities are usually much smaller than CEDP facilities and built and operated by societies which may receive some Fisheries and Oceans funding but mostly receive funding from other sources such as fundraising, various levels of government (eg. FRBC), private companies such as forest companies, or the Salmon Foundation and recently from court fines from fisheries and environmental violations. PIP facilities get technical help from SEP Community Advisors. PIP facilities include:

Gillard Pass *(PIP Facility funded and operated by Gillard Pass Fisheries Assoc.)*
Warner Bay Creek *(PIP Facility)*
Bella Coola River *(PIP Facility funded by the Central Coast Fishermen's Protective Assoc.)*
Charles Creek *(closed PIP facility)*
Kitasoo Creek *(closed PIP Facility prior to Klemtu Hatchery)*
Ocean Falls *(PIP facility now closed)*
Scott Cove Creek *(PIP Facility funded by the Mainland Enhancement of Salmonid Species Society)*
Martin River *(closed PIP facility)*
Shotbolt Bay *(PIP Hatchery funded by the Rivers Inlet Sport Fisheries Assoc. and F&O)*

Orford Hatchery is different from other CEDP's in that it was initiated, built, operated, and maintained by a Native Band with technical help from an Environmental Consultant with its own sources of funding and limited involvement of Fisheries & Oceans.

Fisheries and Oceans have funded enhancement projects in the schools of the Central Coast and the Cariboo-Chilcotin.

APPENDIX C: LIST OF DFO/MELP SENSITIVE FISHERIES WATERSHEDS

Watersheds Sorted Alphabetically by Name

Watershed Name	Unit #	Watershed Name	Unit #	Watershed Name	Unit #
Aaltanhash	N - 2	Johnston Ck	N - 16	Pyne	N - 1
Ahnuhati R	S - 8	Kainet Ck	N - 2	Quartcha Ck	N - 4
Ahta R	S - 8	Kakweiken R	S - 8	Quatlena R	N - 10
Ahta Valley Ck	S - 8	Kakweiken R, Lower	S - 8	Read Ck	S - 10
Allison Ck	S - 5	Kamin	N - 1	Robber's Nob Ck	S - 10
Arnoup/Arnoup trib	N - 1	Khutze	N - 2	Robson Ck	N - 6
Ashlum	N - 14	Khutze, East	N - 2	Roscoe Ck (Nootka R)	N - 4
Atlatzi R	S - 2	Kilbella R	N - 14	Sakumtha R	N - 6
Atnarko	N - 12	Kilippi Ck	N - 14	Salahagen Ck	N - 6
Atwaykellise R	S - 2	Kimsquit R (upper/Lower)	N - 6	Salient Ck	N - 6
Bella Coola	N - 12	Kimsquit R trib (U/L)	N - 6	Sallie Ck	S - 9
Bernhardt Ck	N - 6	King George Ck	N - 6	Saloompt	N - 12
Blind Ck	S - 9	Kingcome R	S - 2	Schoal Ck	S - 10
Bloomfield	N - 1	Kitasoo Ck	N - 3	Scott Cove Ck	S - 7
Boughey Bay Ck	S - 10	Klinaklini R	S - 3	Scow Bay	N - 1
Call Ck	S - 10	Klinaklini R, North	S - 3	Scow Bay Ck (tributary)	N - 2
Camelion Harbour Ck	S - 10	Klinaklini R, Upper	S - 4	Seymour R	S - 2
Canoona	N - 2	Knox Bay Ck	S - 10	Shemahant	N - 15
Chapple Ck – Head of Kiln Inlet	N - 1	Koeye R	N - 10	Siah Ck	N - 6
Charles Ck	S - 6	Kull Ck	N - 15	Sim R	S - 3
Chatsquot Ck	N - 6	Kwakusdis R	N - 4	Skuce Ck	N - 6
Christie Ck	S - 10	Kwalate Ck	S - 8	Smaby Ck	N - 6
Chuckwalla R	N - 14	Kwap (Amback)	N - 14	Smoker Ck	N - 14
Clear R	S - 2	Kwatna R	N - 10	Smyth Ck	S - 3
Clyak	N - 10	Lagoon Ck (incl.Roderick L)	N - 3	Snootli Ck	N - 12
Cornice Ck	N - 6	Lahlah Ck	S - 2	Soda	N - 2
Cornwall Inlet, East Arm/head of	N - 2	Lemolo Ck	N - 15	Sonora Island, Unnamed Stream	S - 10
Dallery (Upper/Lower)	N - 14	Lull Ck	S - 9	Stafford R	S - 11
Dean R/Dean River trib	N - 6	Machmel, Inc. Clear Ck	N - 14	Stanton Ck	S - 3
Devereux Ck	S - 3	Mackenzie Sound Ck	S - 6	Surf - incl Cougar, Bear & Deer L	N - 1
Dice Ck	S - 3	MacNair Ck	N - 10	Taaltz Ck	S - 6
Dome Ck	N - 2	Magson Ck	S - 2	Talchako	N - 12
Douglas	N - 1	Maple Cove Ck	S - 7	Taleomay R Inc. Tarrant Ck	N - 11
Drake Inlet, West Arm – head of	N - 2	Martin R	N - 5	Tankeeah	N - 4
Elbow Ck	S - 8	Matsui Ck	S - 9	Tarrant Ck	N - 11
Elcho Ck	N - 5	McAlister Ck	S - 8	Tatsquan Ck	N - 12
Ellerslie Lake	N - 4	McIsaac	N - 2	Thorsen Ck, Lower	N - 12
Embley Ck	S - 5	McMyn Ck	S - 3	Thurston Bay Ck	S - 10
Fanny Bay Ck	S - 10	Meers Ck	S - 2	Tom Browne Ck	S - 9
Foresight Ck	N - 6	Milton R	N - 10	Trahey	N - 1
Franklin R	S - 3	Mussel R (Bear R)	N - 2	Trapper Ck	N - 6
Frederick Arm Ck	S - 10	Nais	N - 1	Tumult Ck	S - 3
Fulmore R (& tributaries)	S - 10	Nechanz, Inc. Marble Ck	N - 14	Tuna R	S - 10
Genesee	N - 14	Necleetsconnay / trib	N - 12	Tyler	N - 1
Gilford Ck	S - 7	Neekas Ck	N - 4	Tzeo	N - 15
Glendale Ck	S - 9	Nekite R / trib	S - 1	Viner Sound Ck	S - 7
Glendale R, Upper	S - 10	Nooklikonnik Ck	N - 12	Wahkana Bay Ck	S - 7
Grassy Ck	S - 10	Noosgulch R	N - 12	Wahpeeto Ck	S - 2
Gray Ck	S - 10	Nootum R	N - 10	Wakeman R	S - 2
Green Inlet	N - 2	Nusatsum R	N - 12	Wale	N - 1
Hemming Lake Ck	S - 10	Owen Ck	S - 10	Wannock R	N - 14
Heydon Ck	S - 10	Owikeno Lake (6 basins)	N - 14/15	Wash Wash	N - 15
Icy Ck	S - 3	Packe	N - 1	Waump Ck	S - 5
Inziana	N - 15	Pashleth Ck	N - 14	Wawwatl Ck	S - 2
Jackson Bay Ck	S - 10	Phillips R	S - 11	Wortley Ck	S - 10
		Pollard Ck	N - 6		